THE ENGINEERING MAGAZINE

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THE COMMON SENSE OF THE ISTHMIAN-CANAL DECISION.

An Editorial Review.

THE choice of the Panama route for the Isthmian canal is a striking case of sound reason, based on engineering certainties, winning a hard fight over sentiment and mistaken or prejudiced partisanship. It is a conclusion in which the United States was practically sole arbiter, but the whole world vitally concerned, each nation's interest in a right decision (as pointed out heretofore in these pages) being in almost direct proportion to its sea-borne commerce and especially its shipping. Every consideration of physical economy was on the side of the Panama route. Its plea for favor on account of its shortness, its lower lockage, its easier curvature, its cheaper and less troublesome regulation, its much slighter exposure to earthquake damage, its greater safety and service to shipping, its almost absolute assurance against any unforeseen difficulties of construction—this plea was unanswered, and unanswerable. But against it was raised a clamor for another route, based largely on a misunderstanding, but more difficult to deal with because its moving principle was sentiment, and sentiment for a time overpowered sense. There is nothing so hard to change by argument as a "party watchword." It becomes a thing almost sacred, and he who questions it thereby puts himself beyond the pale of regard or influence. And belief in the Nicaragua Canal for years was taken to be one of the first articles in the creed of American patriotism.

That this was largely based on a misunderstanding has just been said. The misunderstanding was that Isthmian Canal and Nicaraguan Canal mean one and the same thing. The beginnings of this belief are easily found. They lie in the fact that at the time when the cutting of the Isthmus by the United States was first actively urged, the Panama route was seemingly pre-empted by France, and wholly out of reach. It was Nicaragua or nothing, so far as the United States was concerned. Setting the Darien route aside from serious consideration, the only possible American canal across the Isthmus then was the Nicaragua Canal. And the several companies, with many and often-changing names, which sought to seize and speculate in a "concession" for the Nicaraguan rights, were zealous in painting the Stars and Stripes over their very hazy plans. Under proper encouragement, the term Nicaraguan Canal was brought into general use and unfailingly offered to every political convention; the term Isthmian Canal was sent to limbo. The national interest and the national pride were thus almost unconsciously fixed, by the use of a name, upon a locality instead of upon a result. Gradually, that which had been at first by virtue of necessity came to be held as almost of Divine institution. It became heresy even to hint there could be another route, to say nothing of a better route, than the Nicaraguan.

But meantime the situation on the Isthmus had changed completely. On both lines, companies had been at work and had come to wreck. At Panama the undertakings were huge and the ruin proportionate; at Nicaragua, both were pitiful rather than overwhelming. But let anyone who shrinks from Panama on account of a "legacy of failure or shame" study carefully the history of the Nicaraguan attempts.

The whole region was again open for study and choice, without the limitations which had narrowed the field free to the United States at the earlier period. And yet, so strong and lasting is the force of a form of words, well learned and often sounded, that it was with great difficulty Congress was persuaded to seek and then wait for the report of a competent commission; it was with still greater difficulty it was persuaded to act upon the strong and unanimous recommendation of that commission against the clamor of still persistent adherents of Nicaragua. But so strong and sure is the ultimate power of economic fact—so inevitably must the unfit in the realm of engineering give way to the more fit—that clear statement won its way against passionate oratory, and common sense prevailed over unthinking partisanship. Within six months occurred a most

surprising change of view in a law-making body dealing with a long active question. The minority of 102 Congressmen who in December fixed their choice upon the Panama route, if obtainable, in June had grown to a majority of 252. The huge majority of uncompromising Nicaraguan adherents had dwindled in the same time to a handful of 8. With all allowances for those who voted for the Spooner bill because they believed it would be impossible to get as good title at Panama—a belief, by the way, for which there is no foundation whatever—and that therefore the mandatory provision for building the Nicaragua canal would come into effect—with all allowance for these members, the change of understanding and feeling is striking. It is characteristic of the spirit of the times—the spirit which compels the withdrawal of every method and every agency which is less efficient than it might be, in favor of one which does the work better, faster, more cheaply; the spirit which sees that man's duty is to develop the resources of the earth with the utmost economy and with the utmost utility—which recognizes waste, whether of substance, time, or power, as a crime.

It is this inspiration which has led THE ENGINEERING MAGAZINE to take the same stand on the Isthmian Canal question as on every other question of engineering practice treated in its pages. It has worked and fought for the choice of the means which would best serve the end of usefulness and economy—which, in the case of the canal, would most safely, most surely, and most cheaply aid and enlarge commerce and traffic. And these means it firmly believes are found in the Panama Canal. In the faithful championship of this view, now so widely accepted, this Magazine has borne much of the burden and heat of the day, and not a few of the blows. Against the absurd charge of servility to the interests which are said to be seeking to prevent the making of any canal, we need only point to the steady policy of the Magazine, and, even more tellingly, to the first and the latest articles on the question we have published; the former, by Hon. Warner Miller, in March, 1893, setting forth the commercial advantages of cutting the Isthmus; the latter, by Mr. S. A. Thompson, in July, 1902, showing the fallacy of the view that it would work any hurt to the railways of America, and the heartiness with which they should support, instead of opposing, the measures for prompt and vigorous work for the completion of the waterway. Surely, those who in reason are most nearly allied to the no-canal party are they who would make an unserviceable canal—one which by its risks and difficulties would discourage free use by sea carriers; and

our whole contention has been that the Nicaragua Canal, by its length, its tedious lockages, its narrow and crooked channels, its questionable harbor facilities at its termini, and its possible subjection to stoppage by earthquakes, volcanoes, or difficulties of regulation, would reduce to a minimum the possible usefulness of a waterway across the Isthmus. Better have it than have none—but why not have the best of all?

Between these earliest and latest efforts toward what we are sure is the right course, stand a long series of contributions directed steadily to the same end. They were led by Mr. C. B. Going's article on "The Absence of Facts about the Nicaragua Canal" in June, 1896, showing the wholly unsatisfactory character of the case for that route, the many serious problems unsolved, the reckless folly of going into any irrevocable adoption of the route at that time, and the urgent need of full and careful study of the matter before any final action was taken. The caution which the country adopted at that time saved the expenditure of many millions for an imperfect project and worthless concessions. In July and August, 1898, the end of the Spanish-American war having brought the canal question up again for study, we presented two articles which in the interests of fairness and of argument from all sides were prepared, one by Prof. L. M. Haupt —a strong pro-Nicaraguan, although his argument was in this instance for an Isthmian canal rather than for the choice of any one route in preference to another—and the other by Mr. Joseph Nimmo, an opponent of the canal idea. In October following we published Professor Haupt's rejoinder to Mr. Nimmo, but took that opportunity to state that, so far as the Nicaraguan project was concerned, THE ENGINEERING MAGAZINE was unconvinced of its engineering feasibility or its commercial sufficiency, and was strongly against espousal of the project by the American government.

In December of the same year we reviewed the physical advantages of the Panama route, and urged the injustice and unreason of letting a former financial fiasco blind us to its very great merits from an engineering point of view. In January, 1899, we again protested editorially against taking over the Nicaragua scheme until it had been thoroughly examined by a competent and disinterested commission. This was followed, in February and March of 1899, by two particularly able and convincing papers by Mr. W. Henry Hunter, chief engineer of the Manchester Ship Canal, pointing out the enormous benefits of such a waterway, and comparing very clearly the Nicaragua and Panama routes in matters both of engineering con-

struction and practical navigation. In the following August we reviewed the personnel of the "Walker Commission," with satisfaction that the first point of our contention had been gained, and the whole region was to be thoroughly surveyed before action was taken.

In February, 1900, with the express view of correcting the general false idea that the collapse of the first Panama effort had been due to engineering obstacles, we presented an admirable statement of the present condition of the undertaking by Mr. Charles Paine, past president of the American Society of Civil Engineers, together with a very fine map showing the extent and accuracy of the surveys and the advanced condition of exploratory and actual construction work. In March and April we again protested editorially against the clamor of the Nicaraguan party, who, apparently fearful of the results of examination, urged that their route be chosen without waiting for the Walker Commission's report. In April also we published a very concise and instructive comparison of the two routes by Mr. George A. Burt, bringing out vividly their differences in point of ease of navigation. June, 1900, we reviewed at length certain grave geophysical difficulties apparent in the Nicaraguan route, especially the shifting sands at Greytown Bight, the dangers of earthquake and volcanic disturbance, and the question of a changing level in Lake Nicaragua, and developed this last point quite fully in a review of Professor Heilprin's notable studies of this point and Mr. C. Willard Hayes' not fully satisfying reply. September, 1900, we discussed Mr. Wheeler's report on the topography of the Nicaragua route, which brought out with new distinctness the difficulties of canalizing the San Juan and dealing with the great volumes of volcanic sand. In April, 1900, we reviewed fully Col. Peter C. Hains' studies of the fortification of an Isthmian Canal in its military and naval aspects, and in June of the same year gave in condensed form M. Bunau-Varilla's striking data of volcanic disturbances, showing, as since confirmed by the disturbances in Guatemala and especially on Lake Managua, that the Nicaraguan waterway would be in great danger of damage from this cause.

In January, 1902, appeared one of the most important of all the contributions we have presented—General Abbot's widely quoted article on the International Aspects of the Isthmian Canal. At this time we made an energetic protest against the folly of plunging into the unknown difficulties and known dangers of the Nicaraguan route, for lack of courage to attack and solve the alleged financial difficulties in the way of getting full ownership of the Panama Canal.

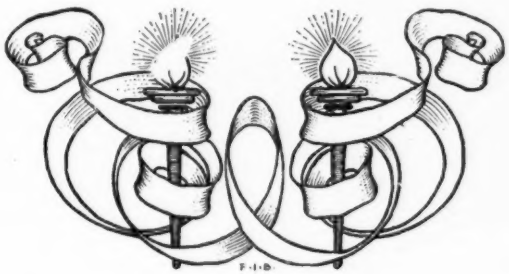
The next month, reviewing the vote in the lower House on the Hepburn Bill, we pointed out and emphasized General Abbot's argument that facility of maintenance and use far outweighed questions of first cost, and suggested the great importance of calling the shipping interests into the debate, as Senator Hanna did so effectively a few weeks later. In the same number we summarized Dr. George A. Soper's conclusions as to comparative sanitary conditions, completely dispelling the illusion that Nicaragua is more healthful than Panama. In March we reviewed our course in the support of the Panama movement, and stated our motives as we have again in this article—the conviction that in industrial life and action, the supreme considerations are plain practicability and utility.

Mr. John George Leigh's review of the report of the Walker Commission from a British standpoint appeared in our issue for April of this year. In June, we pointed out the impressive confirmation of M. Bunau-Varilla's predictions as to volcanic and earthquake dangers in Nicaragua, the proof being furnished by the year's earthquake readings recorded by General Abbot, showing fifty shocks in San Jose de Costa Rica as against five slight tremors in Panama. And in July (last month), besides Mr. Thompson's important article on the general economic influence of waterways, we pointed out the conversion of public thought to true economy as indicated in the passage of the Spooner bill, and forecast the concurrence of the House.

The bill, passed by both houses, has received the President's signature. The way is at last open to the long-hoped-for piercing of the Isthmus—for the joining of the seas which themselves join the continents. If there is a fatal flaw in the Panama title, then the choice must be Nicaragua; but that we do not for a moment fear. All past disputes have been finally settled in the French courts, by which all parties are bound. Governments and owners concur in confirming the transfer. No mere difficulties should be permitted to interfere, if they can in any way be removed. Financial obstacles to the speedy acquisition of Panama will be more readily overcome than the physical obstacles, both to completion and use, which would be met at Nicaragua. It will be far easier to get and keep a clear title at Panama under the laws of France or of America than a clear waterway at Nicaragua under the laws of wind and flood which are shoaling the Caribbean and would oppose every steamer threading the crooked San Juan.

Our unshaken belief in the Panama Canal and in its final adoption by the United States springs from the same roots as our faith that misrule in Africa would go down—that false independence and short-

sighted extortion would unfailingly give way to true liberty and self-government and a policy of justice and encouragement of industry. Another outgrowth of the same creed was our confidence in the restoration of peace in China without seizure or partition of territory, and our forecast of a joint stand by Britain, Germany, the United States and Japan for the integrity of China and free commercial opportunity. The vital force of this philosophy is profound conviction that the supreme figure in the modern world is the engineer, and the supreme test of any material proposition is efficiency. If it makes for greater economy, it will prevail; if it makes for needless waste, it will fall. The rule runs the same whether the thing tried by it be a tool, a labor policy, a ship-canal, a government, or a human institution. The Nicaragua Canal, the Boer oligarchy, the war spirit in the Far East, had the foredoom of failure written upon them because they tend to waste of human effort and material resource. The strike leader, the jingo, the "war lord," are going the same road, and every new proof of the wastefulness of war puts them farther toward complete rejection. The name of Utilitarian is losing its evil sense as it is more clearly seen that every saving of effort or substance leaves man by that much freed for better things. The fitness that leads to survival is fitness in point of economy and efficiency—the fundamentals of all engineering effort. Because he serves these ideals, the engineer is already the foremost figure in the social order, far outranking statesman and soldier. The art outranking all arts is "the art of directing the great sources of power in Nature to the use and convenience of man."



THE TREND OF PRICES IN ENGINEERING INDUSTRIES.

By C. L. Redfield.

Dr. H. M. Chance, in a most thoughtful article on "The Present Value and Purchasing Power of Gold" published in the Magazine in May, 1896, forecast the very conditions which Mr. Redfield discusses in their latest phases in the following article. Rarely is an economic prophecy so strikingly fulfilled as that has been with which Dr. Chance concluded the article just mentioned. The subject has gained new and great importance from the constant and cumulative increase in the rate of exploiting the world's great gold fields. Mr. Charleton's recent articles in this Magazine on Australian gold-mining, Mr. Tonge's accounts of constant progress in Colorado, Mr. Mabson's story of the Rhodesian prospects, told in our issue of March, 1900, Mr. Queneau's article last month on Cape Nome, Mr. Hammond's striking leader on the Transvaal situation in July, Mr. Leigh's description of the Gold Coast this month—all have one burden:—an enormous yearly addition to the supply of gold, and an inevitable fall in the purchasing power of this commodity. The question is even more important from the fact that the world has settled most of its vexing outside problems—in Africa, in the Indies, in the Far East—and has before it an era of busy peace, the progress of which must be accompanied by, and in large measure depend upon, the settlement of the ever-present internal problems of cost of production and payment of the worker. A right view of the meaning and tendency of prices is fundamental to the case, and toward this view Mr. Redfield helps ably. —THE EDITORS.

A COMMODITY is anything which is an article of exchange and which has value because of the human effort expended in its production. The price of a commodity is a statement in arbitrary units of the amount of gold which must be given in exchange for a specified quantity of that commodity. As gold is an article of exchange, and is obtained only through human efforts, it is also a commodity, and as a commodity is subject to the same laws as other commodities. The fact that prices rise and fall shows that the values of commodities vary from time to time, and the fact that the measuring and measured commodities are subject to the same laws indicates that price is a statement of the relationship of one variable to another variable. Any forecast as to the future trend of prices must therefore be based upon a study of the variations in value of different commodities, and to do this properly we must analyze the causes of such variations.

Under the old political economy, the ratio of supply and demand to each other is considered sufficient to explain all variations in price, and under the old conditions this explanation was practically satisfactory. In a limited sense and for particular cases the old formula is true today. It will determine the price when the supply is strictly

limited, as in the case of rare coins, or when the demand changes suddenly, as in the case of articles made to meet the requirement of transient fads and fashions. It is also an explanation of temporary fluctuations in prices; but for staple articles the relationship of supply to demand fails as an explanation when we consider the gradual changes in prices which take place during considerable periods of time.

At the time when the law of supply and demand was first stated nearly all production was the result of hand labor, and the productive power of the community sufficed to supply but little more than what food and clothing was completely consumed. As the demand for food to sustain life and clothing for protection against the weather is an urgent demand, and nearly constant in quantity, it will be readily seen why a variation in the normal supply should cause a considerable variation in price.

With the gradual introduction of mechanical power and improved machinery, the productive capacity of the community has increased to such an extent that it has become potentially unlimited. The fact that the greatly increased supply of commodities arising from increased productive capacity has neither checked production nor ruined the producers by a demoralization of prices, shows that supply is not of itself the controlling factor of price. The explanation of this may be found in the motives which control human actions. The average producer knows little of the theories of political economy, and cares less. What he is interested in is furnishing some commodity at a price which will give him a reasonable compensation for the efforts expended in its production. As long as this reasonable compensation is forthcoming he will continue to furnish the article, but he seriously objects to furnishing it at a loss, or at a price so close to its cost of production that he is not enabled to obtain a respectable living. When the principal lines of production were limited to food and clothing, the man who was producing commodities at a price yielding only a bare subsistence had few opportunities to change; because of the scanty dissemination of general news he lacked knowledge of opportunities for change that existed; and because of the general lack of capital he could not hold his surplus product nor have it held until a suitable price could be obtained, but was compelled to dispose of it at the immediate market price. He was therefore often compelled to continue the production of a given commodity irrespective of the degree of his compensation or what the market price might be.

All this is now changed. The machinery which increased the productive capacity of the community has added a large number of new

avenues of employment to which he may turn if his own prove unremunerative; newspapers, telegraphs, and a traveling public now keep him informed of what others are doing and of opportunities that exist; increased facilities for transportation enable him to send his surplus to distant points; and the increase of capital and storage capacity permits an unsalable surplus to be held for a more propitious market. With all these opportunities the modern producer will not long continue to furnish a commodity unless the selling price is higher than the cost of production; the practically unlimited power of increasing the supply of a commodity and the ever-present competition will not permit the price long to remain more than a reasonable amount above the cost of producing it; hence, in the long run, the cost of production will determine the price.

When the majority of producers were independent workers, few men knew what the cost of production was, and the market was dominated by the supplies furnished by those who did not know. With the expansion of the wage system producers learned to calculate the cost of producing articles, and independent producers were enabled to determine the same thing by comparing what they received for their labor with what they would receive as employees. In the light of the information thus gained we find the cost of production is a summation of the total effort required in bringing things from their natural state to that condition in which they become articles of trade or commerce.

Effort does not include the natural energy of nature that may be absorbed without expense, as the wind that propels a vessel or the caloric in coal that produces steam, but it does include the human labor involved in spreading the sails and handling the coal. Nor is it confined strictly to labor, as contended by the socialists, but it includes the mental processes of invention, guidance, and superintendence, and a legitimate return upon that condensed labor known as capital. The man who of his own volition and by extra diligence builds a water-wheel and compels the forces of nature to perform part of his own labor, and part of that of his fellow men, is entitled to whatever he has gained by his own diligence and foresight, and also to a small portion of the extra profit gained by those who use his wheel, but did not originate it. In other words, he has, by extra mental and physical efforts, brought about a state of affairs by which less future effort is required to produce certain commodities, and because less effort is required the cost of producing these commodities is reduced. As price is dependent upon cost of production, we see that it may ultimately be traced back to amount of effort exerted, and as the amount of effort ex-

pended in producing commodities is continually being reduced by the action of concentrated effort at previous times, the tendency is for the values of commodities to decline.

What is said in regard to values would be true of prices, if price and value were synonymous; but as prices are measured in a commodity which is subject to the same laws as other commodities, it is necessary to consider the extent to which concentrated effort may reduce the total effort necessary to produce gold, as compared to that necessary to produce other commodities.

Until recent times both gold and silver have been used as measures of values, and both have been produced by manual labor assisted by such tools as the miner could carry with him. As neither metal occurs in large masses, the amount of effort required to produce them long remained a nearly constant quantity, from which fact came the idea that they represented definite and uniform values. In the 70's large silver deposits became available by reason of the introduction of improved machinery. This machinery represented concentrated effort, by the use of which less total effort was thereafter required to produce silver. The consequence of this was a reduced cost of production, and this reduced cost was in a few years reflected by a fall in the price of silver compared with gold. If, during this period, silver instead of gold had been the standard for measuring price, it is evident that prices, as commercially stated, would have risen, though there would have been no rise in values. It would simply have been a case of stating prices in units of continually declining value.

During the last decade concentrated effort has been going into the production of gold, exactly as it went into the production of silver some thirty years ago. This concentrated effort has been, and is now, reducing the cost of producing gold. Owing partly to the comparatively short time through which the improved methods of producing gold have been in operation, and partly to the temporary shutting off of the least expensive supply, by reason of the South African war, the amount added to the general stock at the reduced cost of production has affected market values to only a limited extent. With the reopening of the South African mines and a continuance of the process of reducing the cost of producing gold, its value as a purchasing commodity will decline. It is impossible to say to what extent the value of gold will decline, but it seems probable that during the next twenty years the decline will amount to about fifty per cent. Whatever may be the extent of this decline, we may be quite certain that it will be considerable and will continue for a number of years. We may there-

fore say that in the immediate future prices will be stated in units of continually reducing value. In other words, it will take an increasing amount of gold to pay for articles which have a uniform value.

The obvious meaning of this is that prices will rise, but it does not follow that all prices will rise. Some will rise while others will fall. To determine whether or not the price of a given commodity will rise or fall we must first determine the percentage of effort that may be saved in its production, as compared with the percentage saved in the production of gold. We have already suggested that the probable saving in the cost of producing gold will be about fifty per cent. Those articles for which the saving will be greater than this will fall in price, while those for which it will be less will rise.

This may be illustrated by a few concrete examples. From ore to finished product, nails are produced principally by natural forces acting through machinery and under human supervision. While the amount of human effort consumed in the production of nails will undoubtedly be reduced from time to time, this human effort is now a very small part of the total energy consumed, and it is not probable that the percentage of reduction can equal that for gold. With considerable confidence we may therefore say that nails will be higher in price twenty years hence than they are now. What is true of nails is also true of the majority of those staple articles which are now produced principally by automatic machinery. We may say the same thing of the mass of agricultural products, because the element of time in production cannot be reduced to an appreciable extent, and because the reductions obtainable through larger product from a given area and through improved shipping facilities form only a small part of the total cost. We may also find other reasons why the prices of agricultural products will rise. Land, being a natural product, cannot be reduced in cost by improvements in processes of production; being strictly limited in supply it will rise in price by reason of increase in demand, even without any concurrent fall in the value of gold. These will cause an increase in the cost of producing agricultural products which probably will fully offset any reduction of cost in other ways. From the foregoing it will be evident that the future rise in prices of agricultural products will be a fairly good index of the concurrent fall in the value of gold.

The commodities which in the future will fall in price are those now produced by hand labor, but which may be produced by machinery, and those which are now produced in small quantities by isolated producers, but which may be produced by large combinations. These

articles are principally articles of luxury, fancy articles, and the odds and ends of commerce.

We have determined value to be a representation of human effort, and price to be a statement of value in units of continually declining value. From these we may determine that labor of a given quality will, in the future, command higher prices. But labor, through education and training, is becoming more efficient, and consequently wages will rise faster than the value of gold will fall. The argument that the continual displacement of human labor by the introduction of machinery will glut the market with idler laborers whose competition will reduce wages is not a good one. The man who by the displacement of manual labor makes fifty thousand dollars does not carry that fifty thousand around in his pocket nor does he put it in a safety deposit vault. In neither of these places would it be of any use to him, and no man will exert himself to obtain that which is useless. The only way that he can make that money useful to him is to employ it, and the only way that it can be employed is to set men to work making something. What therefore his machinery enables him to avoid paying to labor for making one thing, he immediately pays to labor for making something else. This is an addition to the world's supply of things which would not have existed except for the introduction of his machinery, and as the new things are usually those which demand higher rates of pay, the scale of wages is thereby increased instead of decreased. The engineer who earns ten or twenty dollars a day is the descendant of a man who a few generations ago considered himself fortunate in being able to get fifty cents a day. It was the displacement of labor by the introduction of machinery which brought about the conditions that have made the engineer possible. If improved machinery and improved methods had not been put into operation, the ten-dollar man of today would be struggling along on the miserable pittance received by his ancestors.

WEST AFRICAN GOLD MINING AND THE "CONCESSIONS INDUSTRY."

By John Geo. Leigh.

Mr. Leigh's article has two important features—first, the very wholesome discouragement of reckless and visionary gold-gamblers, and, second, the intimation that to strong, sound, and well managed companies, guided by good engineering advice and contented with moderate dividends, the Ashanti gold reefs may offer opportunities comparable with those of the Rand. The support which such a prospect gives to Mr. Redfield's argument advanced in the preceding article is obvious.—THE EDITORS.

PLACE before an average man, and any but a very exceptional woman, having a small amount of capital at disposal and consequently an exaggerated estimate of its importance, two prospectuses—the one inviting coöperation in a sound industrial enterprise offering opportunity for reasonable dividends; the other dilating upon the untold wealth hidden in a gold mine in some country of which the recipient of the document has previously scarcely heard—and there is little doubt as to which will claim the larger share of attention. Moreover, if, as usually happens, the second prospectus comes to hand after systematic advertisement of the auriferous wealth of the said country and certain more or less hypothetical fortunes won therefrom, and can point to the possession by the new-born company of a live lord, or a baronet or knight, at least, among its directors, the desired result is doubly assured.

Truth to tell, an irresistible fascination is exercised over the minds and purses of most people by an alliance of the two substantives "gold" and "mining." The most, or only, familiar form of mining is that which places coal within the reach of everyone, and by the majority of the uninformed—their name is legion, regardless of degree—gold in its natural state is always associated with nuggets. The effect of this conjunction of ideas, that gold lies buried in masses a short distance below the surface of some favoured spots and can be won without considerable labour and cost, is usually disastrous to those who entertain it. They fall ready victims to the wily phrases of company promotion and,

THE CROSSING OF A JUNGLE RIVER.

hurrying, as they hope, to enrich themselves, learn all too late that their fancied bonanza existed only in the heated imagination of the compilers of the prospectus, or, at best, had swallowed more of the precious metal than it could ever disgorge.

These remarks are apropos of perhaps the most extraordinary boom which has agitated England since the palmy days of the "Kaffir circus," when every man, woman, and child deemed it a patriotic duty to assist in the exploitation of the auriferous and diamondiferous reefs of Southern Africa. Much money, of course, was made and lost in the historic cycle boom and the flotation of West Australian gold mines, but these episodes, though striking in their way, lacked many of the characteristics of the movement which, a few years ago, necessitated an enlargement and subdivision of the Stock Exchange mining department.

In an interesting article contributed to THE ENGINEERING MAGAZINE some two years since, reference was made to the influence of "apt alliteration" in popularising the magnificent railway scheme so long associated with the magnetic personality now at rest in the Matoppos Hills. There is much in a name, and "gold mining on the Gold

SANSU MILL SITE, ASHANTI GOLD-FIELDS CORPORATION.

Coast" has proved a phrase dangerously fascinating even to the most unimaginative minds. History and legend are in large degree accountable for the witchery, for the region of the Gulf of Guinea has, since Europeans first became acquainted with it, been regarded as rich beyond the dreams of avarice in hidden stores of the ever-coveted metal. Whatever may today be thought of it, there is no doubt that in the past the Gold Coast was no misnomer.

A MAIN STREET IN AN AFRICAN GOLD COAST VILLAGE.

It is interesting to note that as long ago as 1470, the Portuguese, the original discoveries of the land, conferred upon one of their earliest settlements the name La Mina (Elmina), in honour of the quantity of gold obtained therefrom. We know also, on reliable authority, that Captain Thomas Windham on a single occasion in 1551 conveyed to England 150 pounds of gold dust, and that a second English expedition, fitted out a few years later under Captain John Lok, brought from the now famed golden land precious metal weighing 400 pounds and 250 elephant tusks. The Portuguese for many decades looked upon their West African possessions as one of their principal sources of revenue, but during the few years before and many following the cession

EUROPEAN AND NATIVE QUARTERS AT A WEST AFRICAN MINE.

to Holland of the entire Gold Coast, in recompense for the withdrawal of Dutch claims to Brazil, gold appears to have occupied a subordinate position among exports from the country. The reason for this is by no means clear, for William Bosman, chief factor for the Dutch at Elmina, in his "New and Accurate Description of the Coasts of Guinea," published early in the eighteenth century, says that all the rivers and streams contained gold dust, and mentions several districts in which, according to native report, the metal was abundant in the shape of nuggets. In more recent years, private estimates and official returns serve only to increase the surprise that gold has not been forthcoming in larger quantities. For instance, in 1816, one authority rated the annual export from the Coast at 100,000 ounces; five years later a second estimated its value at £3,406,275; while a third tells us that Britain's receipt of gold from the whole of West Africa during the three years ending 1834 was but £250,000. Judging from official figures dealing with subsequent years I am inclined to think the last estimate substantially correct, for I find that during the decade 1886-95 the annual exports of gold from the Colony were:—

	Weight ozs.	Value £		Weight ozs.	Value £
1886	20,799	74,828	1891	24,475	88,112
1887	22,547	81,168	1892	27,446	98,806
1888	24,031	86,510	1893	21,972	79,099
1889	28,667	103,200	1894	21,332	76,796
1890	25,460	91,657	1895	25,416	91,498

This shows an average of 24,214 ounces, valued at £87,167, which, be it noted, favourably compares with many later years. Yet, dur-

ing these, scores of English companies, assisted by American managers and engineers, have been hard at work endeavouring to develope the industry.

Before reference to these efforts and the "boom" which, for a time at least, placed much of the wealth of England at their disposal, mention should be made of the reputation, now two centuries old, of Ashanti as a land abnormally favoured by Nature in her distribution of gold. The Ashanti nation, which for so many years was as a thorn in the flesh of the Gold Coast, appears to have reached the zenith of its power early in the last century. Frequent conquests, the command of an army which included practically every able-bodied man in the country, and the possession of a plentiful supply of fire-arms, induced the Ashanti kings to consider themselves invincible, and this supposition received no little encouragement when the hinterlanders, in 1816, besieged Cape Coast Castle and Annamabo, were bought off by the English governors, and made themselves masters of the entire littoral from Assinie to the Volta. So disturbing to trade was this state of things that the Royal African Company sent

A VISIT FROM THE KINGS OF ADANSI.

a mission to Kumasi, an interesting account of which appears in a book published in 1819 by T. Edward Bowditch, one of the delegation. If Kumasi really was what Bowditch described it, its wealth must have been astonishing, for we are told that, at the reception of the mission, "the sun was reflected, with a glare scarcely more sup-

ONE OF THE GOLD-COAST AMALGAMATED MINES.

portable than the heat, from the massive gold ornaments which glistened in every direction." The king sat on a throne, and was resplendent with breast-plate, anklets, and sword hilt, all of solid gold; his guards wore belts and his band played instruments of the same precious metal; even the most lowly of his attendants were decorated with layers of fine gold chains, while every native in the town seems to have been adorned with what would now be costly jewelry. Echoes of the same tale have come to us in later years; for instance, Captain Boisragon, after visiting the Ashanti capital in 1892, wrote that "The king alone was a sight to see, being a mass of gold from a kind of fireman's helmet he had on to the tips of his sandals, which alone must have been worth some hundreds of pounds."

What has become of all this wealth? Was it the product of the soil, and, if so, is it not reasonable to suppose that there yet lies buried in the ground and in the beds of the rivers and streams of Ashanti and its southern neighbour as much at least of the precious metal as was ever extracted by native methods, crude and wasteful? These are among the questions repeatedly asked by men of enterprise, or by those who, without aspiration to be themselves enriched, long for the peaceful developement and civilisation of heretofore unhappy, despoiled West Africa. To the first inquiry, wonderful though it be that a country almost weighed down with gold should in a few short years have lost everything, it is not possible to return a satisfactory

answer; to the second and third, more important because they deal with the future, there seems but one reply—and that an emphatic affirmative. For the somewhat remarkable fact that there is yet a dearth of convincing evidence wherewith to justify this optimistic attitude, Britain has to thank some of her sons, "too clever by half," in the heart of the Empire and in the Colony.

Legitimate attention was directed to the Gold Coast and its hinterland as profitable fields for British enterprise by the virtual annexation of Ashanti in 1896,* the suspension of mining operations in the Rand consequent upon the outbreak of the South African war, and the final suppression of the rebellion which broke out at Kumasi in April, 1900. Many ventures, concerning which few words of disparagement can be said, were in rapid succession brought before the public, and the response of the latter was such that, for quite a considerable period, scarcely a day passed without the issue of a number of prospectuses, dilating in more or less glowing terms upon the exceptional value of the concessions acquired by the new-born companies and the certainty of early and profitable returns. A conspicuous percentage of these ventures, fortunately perhaps for some of the persons concerned in their flotation, stopped short at the allotment stage; while others ended brief, inglorious careers in liquidation, voluntary or otherwise. Nevertheless there still exist many hundred companies—particulars of no fewer than 420 appear in the recently published *Mining Manual*—whose shareholders presumably expect to handle dividends derived from West African gold. I regard it thankfully as no part of my duty to play the *rôle* of prophet in this matter, and am well content to echo, without comment, the views of others better qualified, by reason of City experience, to assume the dangerous distinction. One authority to whom I put the necessary

* It was not until September of last year that Ashanti was formally incorporated into the Empire,and an end made of an administrative interregnum perplexing alike to officials and the natives. Heretofore, even at Kumasi, the native kings shared in the government; the chief British representative continued to be styled "Resident," and his duties were practically undefined. Under the new arrangements, however, the relations of Crown, colony, and conquered territory were placed on a new and positive basis. The Gold Coast remains a Crown colony, with limits somewhat enlarged at the expense of Ashanti; the latter was constituted an independent possession, while the Northern Territories were "placed under the protection of his Majesty the King," or, in other words, become a "sphere of interest" until such time as their political or economic worth calls for a closer bond. Under the new *régime* Major Nathan, the governor of the Gold Coast, was appointed also governor of Ashanti, with power to appoint a chief commissioner (Captain Donald Stewart, whose excellent work as resident at Kumasi thus received appropriate recognition), and other officials needful for the administration of the country. He was also directed to respect "any native laws by which the civil relations of any native chiefs, tribes, or populations under his Majesty's protection are now regulated, except so far as the same may be incompatible with the due exercise of his Majesty's power and jurisdiction, or clearly injurious to the welfare of the said natives."

AYENIM MILL, ASHANTI GOLD-FIELDS CORPORATION.

A PROSPECTOR AND HIS CARRIERS.

questions was sufficiently optimistic to opine that some sixty companies would prove remunerative investments, and that probably two-thirds of those whose shares still stand at a premium would justify this position. A second was by no means equally hopeful and inclined to estimates at least fifty per cent. less favourable; while others hovered practically between the two opinions. All, however, agreed that, given time and patience, the Gold Coast and Ashanti would prove themselves to be very highly mineralised and consequently deserving of great commercial interest.

In all British colonies, and especially those yet unblessed with representative government, commercial transactions between whites and natives are very strictly ruled for the protection of the aboriginals. Particularly, and very properly, is this the case in all matters relating to the alienation of land. Often, however, a question arises whether the "man and brother" principle is not occasionally so strained that manifest injustice is done to the white, while the other party is made objectionably overbearing, even to the extent of relying upon his colour as ample excuse for spoiling the alien. Whatever the cause, this at least is certain, that the West Coast chiefs, in the matter of mining concessions, have usually proved themselves more than a match for the presumably smart individuals of lighter hue with whom they have had dealings. They were quick to see that the white

man, usually acting for "friends at home," desired something in the way of a bargain, and very promptly evinced inclination to oblige. Many scandals have resulted, some of which have been publicly exposed; but the *modus operandi* and evil consequences of the traffic have never been so clearly and authoritatively proclaimed as they were by Governor Nathan in the course of a speech delivered at a dinner of the Chamber of Commerce at Cape Coast Castle in September last. Having referred in not (as I read them) very hopeful terms, to the prospects of general trade and the mining industry, Major Nathan thus proceeded:—

> "This is a somewhat discouraging state of things, but worse remains behind. Many hundreds of concessions have been registered in the colony this year, and notices of them have been filed in the concessions court; and I have never met a gold prospector, barrister, merchant or official, who, when we talk of the gold industry, does not tell me that a large proportion of these concessions are not worth the paper on which they are written. In truth, a concessions industry has grown up, which is quite distinct from the mining industry, and threatens to ruin it and permanently injure the future of the colony. The industry has its centre in this town, where clerks and persons of no standing act as middlemen between the native chief who is willing to lease his stool lands to any person and to any number of persons who will give him money, and the speculator who buys wholesale from the clerks the documents they have executed with the chiefs, without inquiry whether the lands referred to represent any value as a gold-mining property. The speculator hopes to get back from a company the commission money he has paid to the middleman and the earnest money he has paid to the chiefs, together with a very handsome profit to himself; while the company, formed nominally to work the concession, looks to the public and not to the gold on the concession to recoup expenses. It is difficult to protect people from the consequences of their own folly, but I certainly advise the public, before taking shares in any gold-mining company, to see that it has been satisfactorily reported on by a man qualified by his character, capacity, and knowledge to prospect for gold."

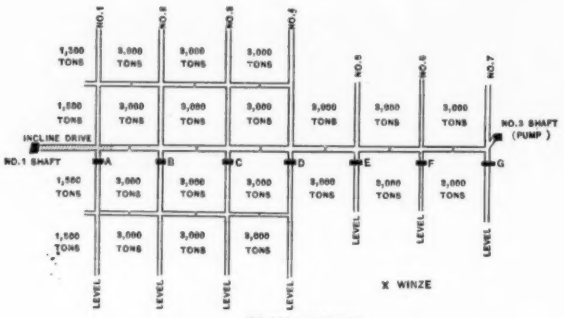
Here we have in concise terms, from the highest official in the colony, a picture of what has been going on for several years. The facts are indisputable and, indeed, have long been notorious, at least in City inner circles. Yet I do not hesitate to think that, were it possible to revive the "Jungle boom" tomorrow, a certain section of the public, despite burnt hands and repeated official warnings, would promptly rush to its support.

Much wiser is the policy which has been adopted by the leading companies and endorsed by their shareholders—to ignore market operations and devote themselves to the developement of their properties in really businesslike fashion. Some ideas may be formed of

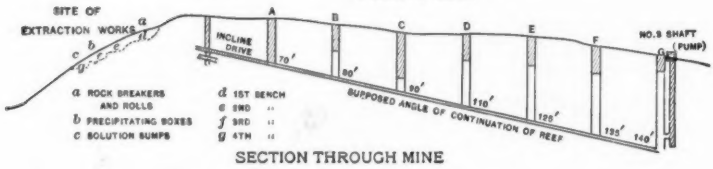
THE TAMSU MILL, LOOKING FROM THE TOP OF THE RIDGE.

CEMETERY FOR MINING MACHINERY, TAMSU.

the severity of the existing slump from the fact that, during three weeks last fall, the depreciation in twelve of the more important companies amounted to no less than £8,250,000. With increased facilities for the transport of machinery and stores from the coast, the work of the next six months should add very materially to the general knowledge of the mineral wealth of the country, and perhaps even result in an early output of gold. The initial mistake made by a majority of the companies was in minimising the difficulties likely to be encountered, with the result that shareholders became disheartened, not only on account of the market outlook, but also because they thought unjustifiably slow progress was being made in connection



PLAN OF MINE



SECTION THROUGH MINE

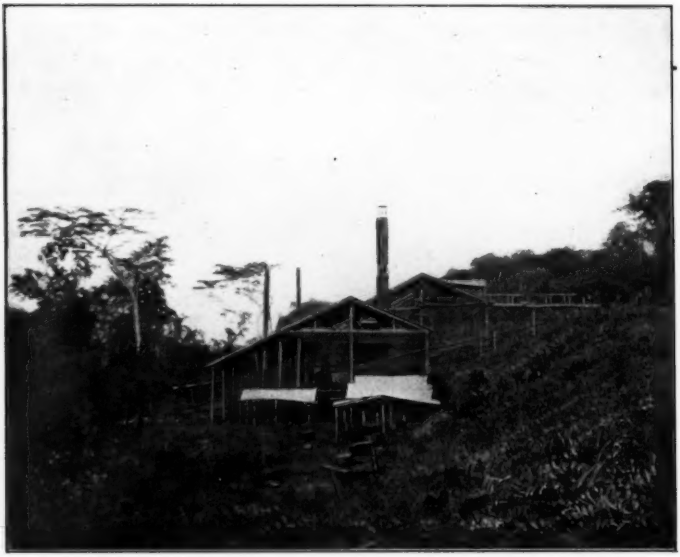
with their properties. Strength was very frequently given to this feeling by the injudicious and, I believe, quite unnecessary reticence observed by directors and officials. In this connection, I gladly draw attention to the accompanying plan and section, not only because of their intrinsic interest, as showing the developement done and proposed by one of the most promising enterprises (one of the Wassau group) on the Tarkwa banket reef, but also on account of the systematic manner in which the shareholders are periodically informed of the progress of the workings. Each investor is supplied with a section map showing the arrangement of the various shafts and levels, and as

reports arrive, postcards are sent from the office giving detailed information as to the footage completed.

Much stress has been laid upon the difficulties of transport from the coast to the mine, and certainly the latter have, in this regard, been very severely handicapped. West African jungle is of the densest descrip-

MARKET AT OBWASSI.

tion, the roads even near the coast should more properly be described as paths, carriers have been few in number and exorbitant in their demands, while the railway, from which so much is hoped, is still in course of construction so deliberate as almost to provoke derision. Work in connection with the line was commenced more than three years ago, but up to the present the only section open to public traffic—a somewhat elastic phrase, as miners and traders know to their cost—is that between Secondi and Tarkwa, a distance of 39¼ miles. In February, after the opening, a friend of mine, travelling to Secondi and back for the purpose of bringing up-country £1,000 in specie, was compelled to travel in open trucks, crowded with native labourers and their accompanying odours and exposed to the full glare of the sun. Each train went off the line only once, which was regarded as evidence of most brilliant engineering; and one of the trips was accomplished in the phenomenally brief time of 6½ hours, an average of one mile in ten minutes, over which the officials crowed consumedly. For the railway, such as it is, or will be, the colony must primarily thank, not the Government, but the Ashanti Goldfields Corporation. The



MILL AT TAMSU.

latter, finding the authorities unwilling to incur the risk of the enterprise, undertook to guarantee, for a term of twenty years, payments sufficient to make up the net annual receipts to £20,000 as soon as the railway reaches Obuassi, the center of its property, and to increase the guarantee to £30,000 when the track is completed to Kumasi, a distance from Secondi of 169¼ miles. In official circles, a hope is entertained that the rails will touch Kumasi by the end of 1903, but local opinion is by no means equally sanguine.

Reference to the railway has necessitated departure from a policy which I intended to pursue throughout this article, namely to avoid mention of particular companies. The Ashanti Goldfields Corporation, however, seems to occupy a unique position among the enterprises engaged in exploiting West African quartz reefs, inasmuch as more than a year ago it reached the producing stage and can already point to an output of many thousand ounces. Its experience, therefore, is not without value in connection with the belief of many West Africans that crushing on quartz reefs will, for some time at least, give a greater output of gold than the banket formation. Many thousands of tons crushed in the Obuassi district have averaged 2 ounces of

gold. This is probably a very exceptional yield, but an all-round one-half as good cannot fail to have important results, if, as experts claim, the gold-bearing veins of West Africa have been traced over a greater distance than those of the Rand. It is also noteworthy that the company referred to, which is working nine different mines and employs over 4,000 natives, repudiates in emphatic fashion the accuracy of current assertions as to the difficulty of obtaining labour, claiming that the trouble, where it exists, is usually created by those who complain of it rather than by the natives. Often enough, there is much to be said in support of this theory; and equivalent discrimination is not undesirable in connection with that permanent obstacle to the developement and civilisation of West Africa—the evil reputation of its climate. There is little hope that, in our time or for many generations to come, science will achieve much in lessening the perils to life and health which lurk in all directions. In the meantime, however, much might be done by Government, employers, and even the most subordinate among the white residents, to improve existing conditions. In olden times, before hinterlands were thought of, all the whites, by force of circumstances, were compelled to live on the

MEMBERS OF MINING STAFF AND THEIR QUARTERS, GOLD-COAST AMALGAMATED MINES, TAMSU.

low-lying coast, in places long since recognised as within the fever zone. Nowadays, except in rare instances, there exists not the slightest necessity for such gratuitous courting of danger; nevertheless, thanks to innate conservatism, the parsimony of Government, and the false economy of employers at home, the administrative and commercial headquarters of each colony remain where they were placed hundreds of years ago, and comparatively healthy spots a few miles inland remain deserted. Moreover (and this applies unhappily to not a few of the gold-mining companies), the notorious disrepute of the West African climate has fostered two ideas;—First, that slightly enhanced remuneration must be regarded as sufficient *quid pro quo* for all risks, and as relieving the employers from responsibility for even the most elementary measures conducive to the health and welfare of their staffs; and, second, that so long as a man remains uninvalided, it is "good business" to get out of him all the work possible. All this is the most false of economies; the frequent changes of *personnel* cause the work to be almost invariably in arrear

WORKSHOP DESTROYED BY A FALLEN TREE.

and never thoroughly mastered, the natives dislike more than anything else transfer from one authority to another, and the annual saving in passage money disbursed on account of reliefs would go far toward providing funds for improvements calculated to diminish the present almost continuous journeyings to and fro. *Surtout point de*

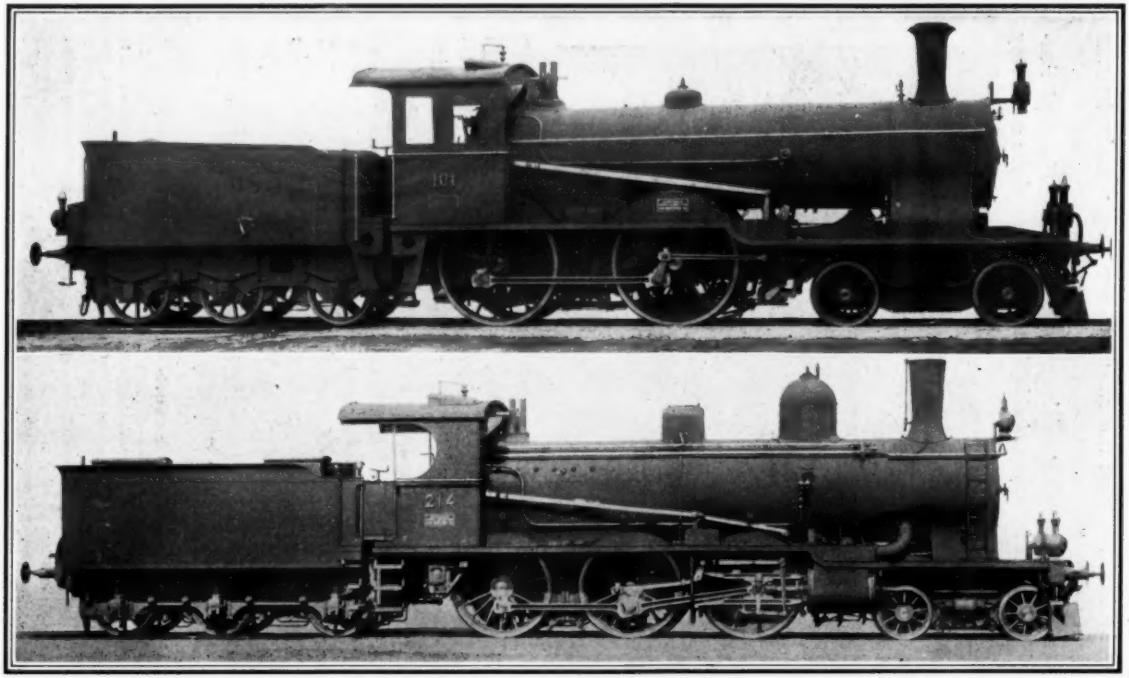
zêle; West Africa is not a country for work at high pressure, and the manager inclined to forget this should be promptly restrained rather than encouraged.

Although the Gold Coast Colony and Ashanti have been particularly referred to, it is very probable that other parts of the coast may

FOUNDATIONS FOR A TRADING STORE, GOLD-COAST AMALGAMATED MINES, ADJA BIPPO.

soon claim attention as gold producers. Thanks to the cloud which at present overhangs the "Jungle," much interest is temporarily devoted to the Ivory Coast, and not a few British companies, which so far have done little or nothing in the way of practical mining, are said to contemplate active intervention in the latest boomlet. There has also been much mysterious talk about the doings and hopes of certain syndicates formed for the purpose of prospecting the hinterland of Lagos, long regarded as a future Eldorado, but the reports of the experts who have examined the various concessions appear to be unanimous in declaring that, whatever advantages the country may possess, gold is not among them.

A few final words concerning the photographs with which this article is illustrated. For those descriptive of the country where are found most of the mines associated with the banket formation, I am indebted to the camera which, in various and widely-sundered parts of the world, has often rendered me yeoman service; for the use of those representing operations in what was once the realm of Kings Kwoffi Kari-Kari and Prempeh, my thanks are due to the Ashanti Goldfields Corporation; while two are selected from many courteously placed at my disposal by the editor of *West Africa*, a journal much to be commended for its consistent championship of honest finance and fair dealing with the natives.



TYPICAL SWISS COMPOUND EXPRESS LOCOMOTIVES.

The engine above is the two-cylinder compound of the Northeastern Railway of Switzerland; its peculiarities are the bent frames and the absence of cams on the cranked axle. It has no dome, and steams without priming. Works compound when the engine is linked up (Winterthur-Mallet device); it has a rocking lever to avoid the use of eccentrics. Below is the four-cylinder compound express engine of the St. Gothard Railway, Switzerland, with direct steam brake on the bogie truck.

FEATURES OF CONTINENTAL LOCOMOTIVE BUILDING.

By Charles R. King.

III.—SWISS, SAXON, RUSSIAN AND NORTH EUROPEAN TYPES.

Mr. King's review began in our June issue. The first portion dealt with the French compound locomotives, the fastest regular runners anywhere. The second described some characteristic Italian and Austro-Hungarian types. The article below concludes the discussion.—THE EDITORS.

THE representative of Swiss locomotive building at the Paris Exposition of 1900 was the compound four-connected express engine of the North Eastern Railway of Switzerland—a very successful type employed in working the fast Swiss services, including the international trains over the line between Zürich and Basel. The engines were designed some two or three years ago by the Schweizerische Locomotiven and Maschinen-Fabrik of Winterthur to the general conditions of Herrn. G. Haueter, chief engineer of mechanical power. They were required to haul trains of 265 tons at speeds of 28 to 32 miles per hour in ascending grades of 1 per cent. High speeds are not general in Switzerland, but the engine mentioned with a train of average weight can easily attain a rate of 56 miles per hour, running very steadily and economically.

The cylinders, which are placed beneath the boiler and have the large diameters of 18⅛ and 26¾ inches, have necessitated the bending of the side frames outward to increase the width by 5 inches, this bending being done carefully after the side plates are bored, punched, and slotted in bundles of four. The plates are 1 inch thick, of Siemens-Martin mild steel or *flusseisen*, and very solidly braced together. The valve gear is Waelschaert-Heusinger's, worked from an outside rocking shaft, a method of transmission adopted because it enables the cranked axle to be made of the simplest form possible, since there are no eccentrics, with their well-known disadvantages as compared with an outside eccentric crank, avoiding beside the inconvenience with large eccentrics for getting at the inside main-rod big ends.

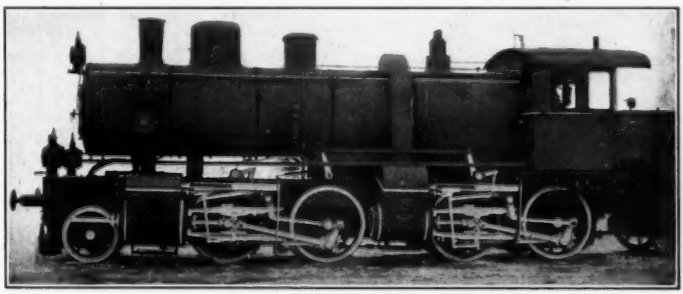
The expansion links are located inside the frames, and the valve-chests, with partially balanced valves, are placed above the cylinders, inclined toward the outside and easily accessible. The cylinders and valve-chests are cast in one piece at the foundry of the adjoining

THE MOST POWERFUL ENGINE EXHIBITED AT PARIS—THE TWELVE-WHEEL COMPOUND OF THE MOSCOW-KAZAN RAILWAY.

works of the renowned firm, Sulzer, and are fitted with a half-automatic starting valve having a double-seated piston valve and combined auxiliary valve for live-steam admission. On starting, and when the reversing screw is at one or the other extreme end of its travel, each of the two cylinders receives steam direct from the boiler and exhausts direct to the chimney, independently as in a single engine. In linking up to a position corresponding to a cut-off of 70 per cent. this valve is reversed and compound working commences. This action may be easily observed in engines leaving stations by the slower and quieter exhaust which takes place after the machine is well started. The main driving rods are of nickel steel from Krupps and the connecting and coupling rods are of Siemens-Martin steel. The blast pipe is of annular invariable type with its orifice level with the top line of tubes. The axle boxes are cast in Martin steel, their rubbing surface lined with bronze and fitted with adjustable wedges. The boiler is of Siemens-Martin mild steel. At the front end the copper firebox is supported by dilatation stays, the rest being the ordinary crown stay bolts. Mild steel is used for the tubes and their firebox ends are of copper. The throttle valve is situated in the smokebox, there being no dome; the Nord-Ost Bahn locomotives have no such boiler mountings, from the fact that a former *maschinemeister*, known as the Swiss "Stirling," was opposed to their use. But as there is never a trace of priming water upon the boiler or chimney—such as used to mark the domeless

broad-gauge locomotives of the Great Western of England—and as the boilers are so far large enough for all present needs, there is with these Swiss engines no necessity for a dome. A collector steam pipe is carried along the top edge of the boiler and has longitudinal slits in its upper surface. On the boiler, in the position usually occupied by the dome, is a manhole surmounted by two safety valves, and two other valves are located in front of the cab. The front truck has a straight pin and its frame has a direct lateral movement. On each side of the pin are two elliptical springs with short camber thrust pins permitting the necessary displacement. The side supports beneath the cylinder casting have their spherical surfaces turned upward instead of, as usual, the reverse. Such a truck might be considered stiff in vertical action as compared to those having a swing frame and no side rests, yet, as an instance to the contrary, it may be mentioned that once when one of these engines was proceeding at 50 miles per hour down-grade, a front truck tire flew off, and after the accident had been signaled to the engineman by a platelayer it was found that a considerable distance had been run upon the wheel rim without any particular damage to any other part.

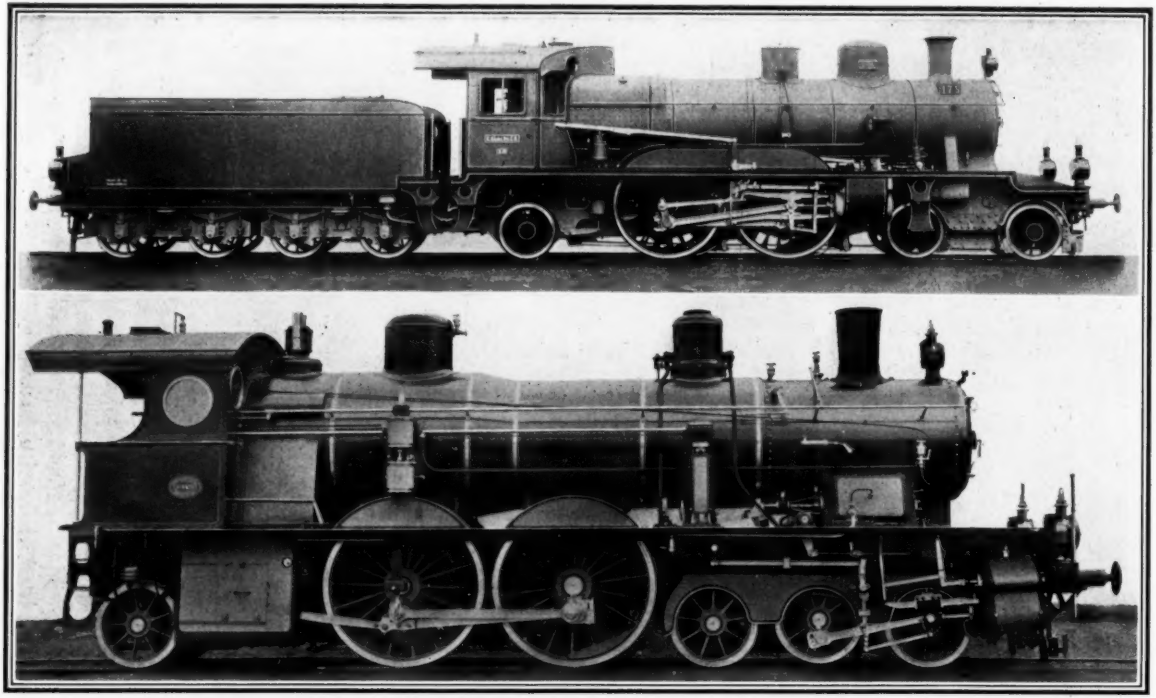
The spring hanging on the driving wheels is by means of plate and spiral springs, and equalising levers are employed between the two pairs of wheels.



BULGARIAN COMPOUND LOCOMOTIVE.

An example of the "articulated locomotive," Mallet type. A Mallet engine similar to this takes a heavy passenger and mail train from Basel every morning.

The equipment comprises "Nord-Ost" injectors, Nathan No. 8 oiler, from Friedmann of Vienna, Gresham steam sander from Hardy of Vienna, speed indicator and counter by Klose (inventor of the well-known articulated locomotive), steam train-heating apparatus, and Westinghouse brakes for locomotive and tender.



COMPOUND EXPRESS LOCOMOTIVES OF CENTRAL EUROPE.

The upper picture shows the ten-wheeled four-cylinder compound express passenger engine of the Saxony State Railways; the lower figure is the twelve-wheeled two-cylinder compound Krauss locomotive with auxiliary pony engine on the pilot truck. This engine has been much adversely criticised by English and French journals. The main frames are pierced to make room for the cylinders inside.

The engine, like nearly all Swiss engines, has the boiler sheathed in black "Russian" iron, made not in Siberia but in Germany. Boilers so jacketed keep a very fine appearance, like a polished gun-barrel, as the metal never rusts. The locomotives are kept nearly as trim as on English railways and the sides of the tires, originally turned bright, are in all Swiss engines kept scrupulously polished. The cab and tenders are usually painted a dark green. The total time spent on the cleaning averages 3 hours per day.

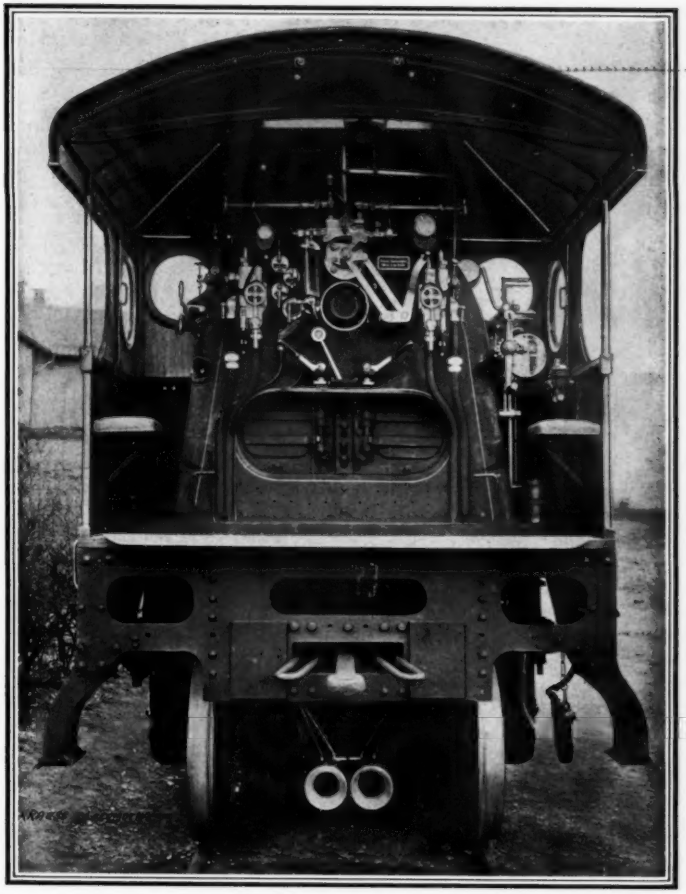
10-Wheeled Four-Cylinder Express Engine, Saxony State Railroads.—This engine, of which two were in service last year, was designed and built by the Sächsischen Maschinenfabrik Actien Gesellschaft, vorm. Richard Hartmann, Chemnitz, Saxony. Being of an entirely new type, like so many of the engines exhibited at Paris in 1900, the engine is still in its trial period on the Saxony State railroads. It will be remembered, in the matter of trial periods, that the first four-cylinder compound engine of the Northern Railway of France was put into service in 1886, and it was not until August, 1891, that the first regular standard engines of the same type commenced service. These Saxon engines are working the fast train services very satisfactorily between Dresden and Leipsic, and comprise in their construction a number of details well worthy of notice. The general disposition of the four cylinders is just that which was so successfully introduced into current practice by the Belfort works of the Société Alsacienne de Constructions Mécaniques, and that arrangement, it need hardly be said, is the only simple one practically available—one which indeed it would be difficult to avoid unless by following either the Woolf tandem, the Vauclain superimposed, the Mallet duplex, or the Adriatic cross-compound. Therefore to class the Saxon engine as being of the de Glehn system would be a simple misstatement of fact, just as it would be to say that M. de Glehn's manner of placing the cylinders was merely Webb's plus an extra low-pressure cylinder. The Saxon engine differs in its starting arrangements for the working entirely by simple expansion—the system employed being Lindner's, admitting, it will be remembered, live steam by a special cock into orifices in the high-pressure slide valves and so located therein that steam from the receiver passing to either side of the high-pressure piston equalises the efforts in the two pairs of cylinders until the engine is linked up, when a four-way cock, operated from a rod connected to the weigh-bar shaft, is closed and the engine works double expansion. This well-known arrangement is very simple, dispensing with special starting valves which necessarily increase the expense of maintenance;

yet notwithstanding this advantage it reduces the starting powers of the engine, while the process of equalisation on the two sides of the high-pressure piston presents certain momentary objections in working, especially in two-cylinder engines.

There is no provision for a direct exhaust from the high-pressure cylinders, as is possible with many compounds and exists in the de Glehn arrangement, such appliances being considered by the Saxon builders to be scarcely ever employed in locomotives so fitted. In this point, only, it is similar to the Adriatic and Mallet four-cylinder locomotives.

For the outside engines Heusinger valve gear is employed, and for the inside or low-pressure engines Joy's valve gear has been adopted, in order to allow the greatest amount of surface possible for the journal bearings and cranks of the front axles. The valves are of the Von Borries type; their relief plates are all of crucible cast-iron and each valve has compensating steam ways—1/2 inch wide for those of the high-pressure, 9/16 inch for those of the Allan balanced low-pressure valves for normal speeds, and 13/16 inch for those of the Richmond high-speed low-pressure valve. The second set of valves for the low-pressure cylinders are intended only for speeds ranging from 56 to 75 miles per hour and for the purpose of giving a maximum of opening for the admission and for lead to the exhaust, with a reduction of compression. All valves are given an inside clearance or lead for eduction—1/4 inch for high-pressure, 1/8 inch for the normal low-pressure valves, and 3/8 inch for the Richmond low-pressure valves. The two distributions can be reversed simultaneously by an ordinary screw, to the slide block of which is attached a notched quadrant, its lever connecting with one, only, of the weigh bars, so that the latter may be operated independently, whenever required, for varying the respective cut-off in the two groups. At high speeds the proportion of cut-off found most suitable for the high-pressure and low-pressure pairs is 40 to 45 and 70 per cent., or a 10 per cent. greater admission for the low-pressure than that we have seen most frequently employed with the French Eastern engines.

The whole of the valve motion is of mild Siemens-Martin steel and its bearings are made as large and ample as possible. The expansion links are of weld iron, cemented and case-hardened, and the dies in the Heusinger gear are of homogeneous iron (mild steel) cemented and hardened, and in the Joy gear these are of phosphor bronze. All have oil boxes to prevent scoring, and are forged solid with the die.



VIEW OF THE CAB AND BOILER END, KRAUSS LOCOMOTIVE WITH PONY-TRUCK DRIVERS.

The cylinders, which have diameters of 13¾ inches and 21⅞ inches by 26 inches stroke, are protected from condensation by a layer of cork composition and by wood cleading covered up by the usual sheathing. Ordinarily on the Continent a hermetic metal sheathing inclosing a layer of hot air is preferred to any non-conductive material. The boiler is of Siemens-Martin steel or *flusseisen* from Krupps of Essen, constructed in the usual way with butted longitudinal seams double welt strapped and double zig-zag rivetted and with telescopic

circumferential seams. A peculiarity to be noticed is the Saxony State Railroad's practice of joining the barrel to the smokebox by a narrow welded ring which, in case of corrosion of the smokebox tube-plate, can be easily replaced without removing any of the long barrel rings. To increase the smokebox diameter a thick hoop is interposed between its circumference and that of the boiler barrel. Steam is supplied to the dome on the forward ring by a collector pipe having transverse slits in its upper circumference and extending back close to the firebox shell crown.

The blast pipe has a fixed orifice calculated, along with the chimney proportions, according to Von Borries. A spark arrester of American type is formed of ¼-inch wires ½ inch between centres. The chimney is of cast iron. At the bottom of the smokebox in front a small trap is provided by which the cinders can be raked out into a funnel let in flush with the front of the running board.

The driving axles and coupled axles are of nickel steel, the driving and coupling pins being of Siemens-Martin steel, case-hardened. The wheel centres are steel castings, cast with their counterweights calculated on Von Borries' formula, and the tires are of crucible steel, the whole of this material being by Krupp. The driving boxes are of cast steel with cast-iron keeps and oil reservoirs below. Their rubbing faces are lined with brass and the axle is made dust tight with felt washers. The horn blocks are single-piece steel castings from Krupps and are fitted with screw wedges for taking up the play at the front guide block.

The frames, 1 3/16 inches thick, are also of Siemens-Martin steel. They are 37 feet 4 inches long and, while cold, are bent outwards 3 inches on each side to give an internal width of 4 feet 6 1/4 inches in order to allow room for the large low-pressure cylinder casting. The side frames are built together very strongly by longitudinal, transverse, and vertical platings.

The front truck pivot is of steel with a half-sphere, 11 3/4 inches diameter, of copper cast upon it and resting in a step bearing in the cradle frame, which is a steel casting. This half-sphere is retained in its bearing by an iron ring between which and the top of the half-sphere there is a play of 3/16 inch to prevent strains. The truck swing frame has a play of 3/4 inch on each side. The bolts supporting the swing links, by which the swing frame is carried at their lower ends, are given a sharp edge to increase the sensitiveness of the suspension. A play of 3/4 inch is also allowed to the radial bearing wheels below the firebox. The method of keeping the wheels normally central

in their radial guides is worth notice. The weight of the engine is here carried by a pair of transverse and inverted plate springs, and their hangers are spread outwards and upwards at each side of the axle to longitudinal yoke arms cast on top of the axle boxes, the inward pull thus exerted tending to keep the wheels flexibly central. To prevent strains from this inward pull a heavy bar is pinned between the crowns of the two opposite radial box guides.

All truck wheels are equipped with brakes, operated from an air cylinder located on the main frame by which a braking effort of 14 tons is effected, equal to 62 per cent. of the weight below the truck tires.

The engine and tender are painted in the usual German colours of dark green for the boiler and red for the wheels. The whole engine and the machine work is of very fine finish.

Tandem Four-Cylinder Compound, Russian State Railways.—This engine is characteristic of Russian design and, apart from its four cylinders, affords a good idea of the generality of Russian locomotives—built without regard to the cramping effects of small loading-gauges, with a height of 15 feet 9 inches and width of 9 feet 6 inches on a road gauge of 5 feet; altogether, to us, not very compact-looking, but probably to Russian eyes presenting a less huddled-up appearance than Western locomotives. This engine, which was brilliantly painted a dark crimson, like those of the English Midland, and relieved with nickeled mountings such a side buffers, name plates, window frames, and beadings, was constructed by the Poutilow works of St. Petersburg to the designs of H. E. the Professor N. P. Petroff. The first of the series was built in 1898, and being very successful in service the type has been definitely adopted as the standard for the St. Petersburg-Warsaw section, there being now some fifty or sixty of this type at work.

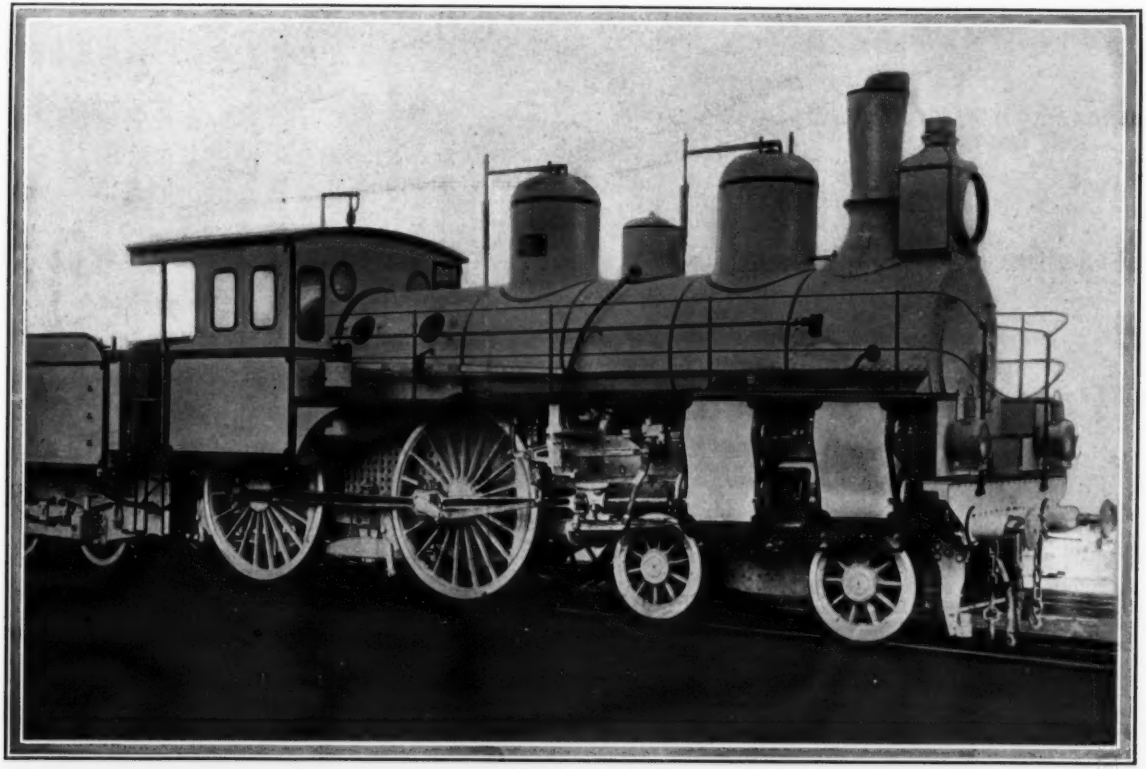
The low speed of Russian trains is often the subject of adverse comment by Westerners, yet in the trials with the first of these locomotives it hauled a train of 250 metric tons the distance of 170 miles from St. Petersburg to Pskow in 3 hours 31 minutes, or at the average speed of 48.5 miles per hour, the velocity up the long grade of 0.6 per cent. being 45 miles per hour, while descending the same grade and on the level the speed was limited to 68.7 miles per hour. Again, with a train of 260 metric tons composed of 10 double-truck coaches, or 360 tons gross load and mounting a grade of 0.5 per cent. with 55 per cent. cut-off in the high-pressure cylinders, the speed of 42.2 miles per hour was maintained.

As in the United States, where the same practice of outside cylinders prevails, the only disposition for a four-cylinder engine is either in vertical or tandem grouping. In both cases the equalised turning effort realised in French compounds and the co-equal division of the stresses in the motion here become lost advantages. This raises the complicated question of low first cost of some locomotives as compared with others of greater durability and costing more for construction but less for maintenance, with longer life to the rails and permanent way, and perhaps also of the enginemen—but this latter does not count.

The Russian State railroad compound has each group of tandemed cylinders bolted outside the frames at an inclination of 1 in 20 from the horizontal. Each pair is cast together with its cylindrical valve-chests and the covers are held up to their seatings by concentric rings and stud bolts. The high-pressure is 14⅜ inches diameter and the low-pressure 21½ inches by 24 inches piston stroke. There is a space of 17½ inches between the tandemed cylinders, and the valve spindle between the valve chests is adjustable by a screw and special lock-nut arrangement. The piston valves, with external admission, are 8⅝ inches diameter. A clearance volume is allowed of 8 per cent. for the high-pressure and of 6½ per cent. for the low-pressure cylinders.

The whole of the motion, including the main and side rods, is of carefully designed proportions combining with the necessary strength great lightness. All rod ends are of the solid pattern with cotters. The valve motion is Heusinger von Waldegg's with closed or box expansion link connected downwards to the eccentric rod by a short extension and the advance lever bent to clear the guide bars. The wheels, of cast steel, are 78¾ inches diameter and have a distance between centres of 9 feet 10 to accommodate the firebox between their axles. The fuel is naphtha and coal. The boiler, which is of iron, has a working pressure of 161 pounds only. The maximum theoretical tractive effort is 14,080 pounds.

In the general construction we notice that the flanged edges of the boiler head are drawn out to long feather edges and welted down to a splice joint inside the sides of the round-topped firebox, the longitudinal seams of which are butted and double strapped. The edges of the copper firebox side sheets are likewise drawn out thin and lapped over the flanged edges of the fire-hole sheets. The "Webb" system is employed in making up the two boxes at the fire hole, but the usual covering lip has been replaced by a simple iron plate at the



STANDARD EIGHT-WHEELED TANDEM-COMPOUND EXPRESS ENGINE, RUSSIAN STATE RAILWAYS.

shovel edge. The curved sides of the firebox shell are braced with a row of four transverse stays; the head and the tube plate are stiffened with angle irons and plate girder stays, but without any longitudinal direct stays. The copper firebox crown is supported by the usual crown bolts and the flue sheet is secured to the rear boiler ring by eight copper stays screwed into the water-space belly stays. Copper ferrules are employed for the tubes at the firebox end. The deep plate frames covering the sides of the firebox are drilled through opposite to each copper screwed stay in order to reveal fractures and facilitate examination and repairs.

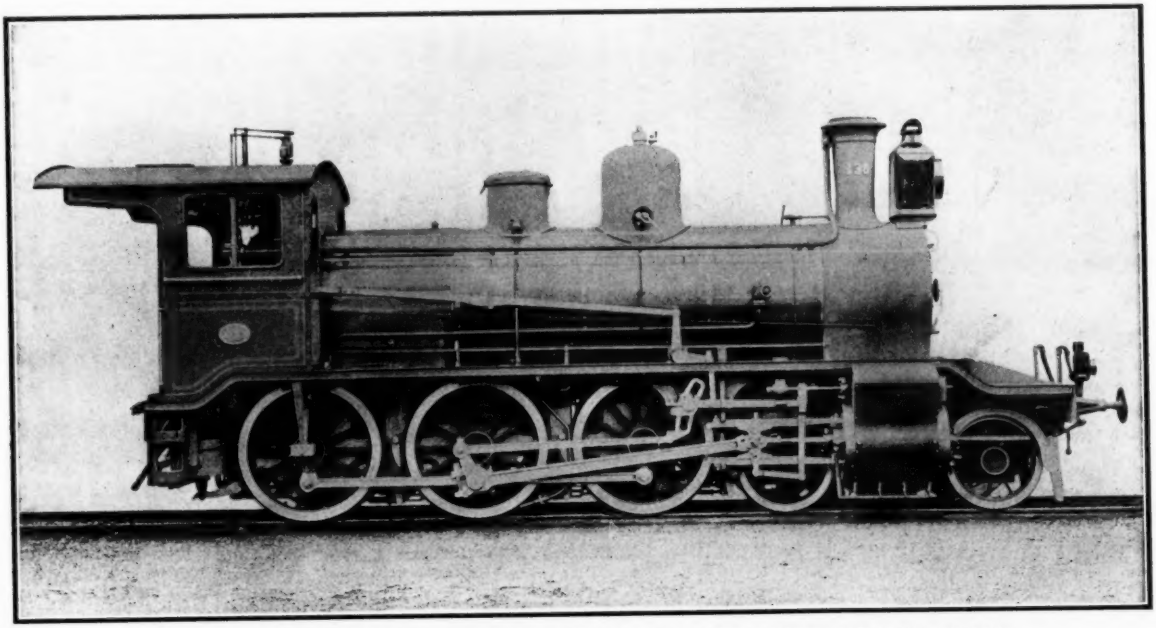
The grate is level and divided into four transverse fixed sections. There is no brick arch. The steel brackets supporting the firebox on the frames are faced with bronze grooved liners. The boiler barrel is lap jointed, smallest ring in the middle, and the smoke-box is increased in diameter by a thick welded hoop over the forward edge of the first boiler ring. As a power reservoir, the boiler capacity is considerably augmented by two high domes, over the first and third rings, and fitted with lever safety valves. These domes are often, in European practice, coupled by an outside pipe. Here they are connected by an inside pipe 5 inches in diameter, joining two cast-iron stand pipes, each of which is fitted with a steam trap that is calculated to knock out the moisture remaining in the steam after it has passed, as it does, through baffle plates in each dome. The delivery pipe in the forward dome reaches to a little behind the throttle valve. By these means the livelier steam of the firebox region is brought nearer to the cylinders, and whether the engine is on up or down grade or the throttle is opened suddenly, the forward dome is certain to get steam as dry as possible. With the well-known greater efficiency and consequent economy of dry steam it is remarkable to find so many devices for getting the heat either by firebox steam or by hot-air chambers to the forward end of the boiler. For the operation of transit cannot possibly take place without loss in traversing these throttling mechanical makeshifts. In the far-off future some master mechanic will probably find out the error.

The throttle valve is of the semi-balanced type, and steam from the main standpipe, 5¼ inches diameter, is conveyed by 3½ inch copper pipes forward through the smokebox to the high-pressure valve chest; the exhaust therefrom is effected by 4¼-inch diameter pipes to the low-pressure and by 5¾-inch pipes from the low-pressure to the blast pipe. The receiver-pipe volume is one-fifth that of a high-pressure cylinder. A rectangular space around the blast pipe is shut in by a

BELGIAN LOCOMOTIVES AT PARIS BEING DISMANTLED FOR SENDING HOME.
Showing how all national initiative, so strong in Belgium a few years ago, has been abandoned for slavish imitation of the Scotch Caledonian locomotives.

perforated spark-arrester, each side of which is equal to the diameter of the chimney base—about 26 inches. This great area of the chimney base is intended to generalise the draft in the side tubes without favouring only those of the centre, already too much under the influence of the blast. For years previous to the Belgic craze for locomotives of Scotch *"façade"* the Belgian railways made use of rectangular chimneys spread out at their bases to almost the full width of the smokebox; likewise the most recent locomotives of the Alsatian railways have the petticoat pipe outside the smoke arch, and double chimneys have sometimes been used for the same purpose. Most engineers appear to think this matter trifling. That the unequal draft resulting from a narrow chimney is a serious defect was seen by the writer from heavy leakages occurring in a Belgian locomotive having three boilers, all in a transverse row, and with but one firebox, one smokebox, and only one chimney. Here, in spite of the large chimney base before referred to, the fire always took the shortest line to the centralised uptake and by unequal dilatation caused much trouble with the firebox tube plate and with the tubes; yet had the smokebox been provided with side chimneys and side blast pipes, the locomotive would have been more successful mechanically notwithstanding its immense flue chest.

The iron framing is very massive. The side plates are 1 3/16

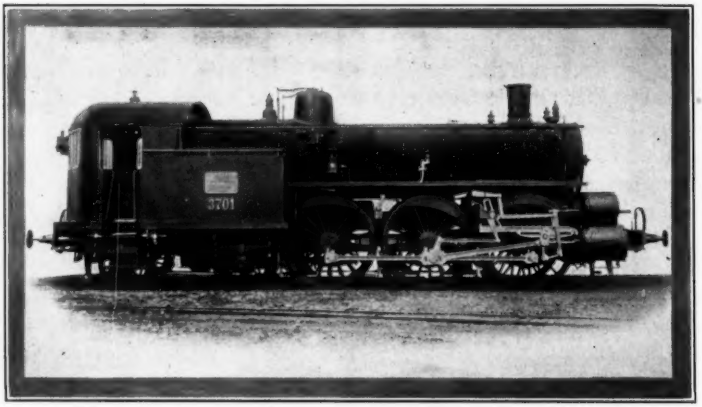


MOGUL TWO-CYLINDER COMPOUND WITH VON BORRIES STARTING VALVE. NORWEGIAN STATE RAILWAY.

inches thick; at the firebox they are 40 inches deep. From end to end the side frames are braced by vertical and longitudinal plates. The length of 5 feet 6 inches from the smokebox to the truck pivot frame is made particularly strong as a fixing for the tandem cylinders. The frame is not riveted to the smokebox as is usual, but instead a bracket plate, riveted to each side of the smokebox, projects downwards and hooks freely over the top edges of the T-transverse saddle plates, allowing thus free dilatation to the boiler at the front end.

The practice, common in England, is followed of fixing the rail-guards (pilots) to the front end of the frame instead of to the truck; this plan is unquestionably the best as it avoids any possible deviation or shock to the truck pin from heavy obstructions. The pivot consists of a hollow steel pin 7½ inches diameter with a 2-foot flange, and is bolted beneath the main-frame caisson, which has a depth of three feet. It is stepped into a steel casting recessed collar plate of larger diameter and this in turn is free to slide transversely along the H section built-up truck bed plate. Seatings of bronze are interposed between respectively the pivot and its collar bearing and between the bearing and its sliding edges on the bed plate. The engine main frames project outwards beyond the truck frame, and brackets bolted outside the latter support a helical spring below each edge of the engine frame, allowing a certain amount of flexibility to prevent strains, only; for the form of the pivot is such as to permit very little adaptation of the truck to superelevations of the rail, at least, other than the comparatively small amount that is always possible with the axle springs.

Binding of the journals against the inner or outer edges of the brass is generally avoided by forming a transversally rounding crown on the latter, so that it may tilt in its box to conform to the slight angle assumed by the axle on curves. In the Russian locomotive the truck brasses and boxes remain unchanged, but the camber buckles are forged with spherical-ended bosses or studs which, resting in a cup bearing on top of the axle boxes, permit as much inclination to the latter as their side flanges will allow. The truck frames are inside the wheels and with inside journal boxes. The journal brasses, as is most usual on the Continent, are flanged around the axle box to form a bearing against the wheel naves and against the axle collar. The iron equalising beams between the driving springs are of unusual appearance, being formed of two trussed iron bars 6 feet 1 inch between the spring hangers; a shoulder iron bracket 1⅝ inch thick is bolted to the frames and passes downward between the two bars upon



4-CYLINDER EXPRESS-COMPOUND, SOUTHERN RAILWAYS OF ITALY.

which the weight is carried by two steel knife-edged fulcrums secured to the bracket. The arrangement appears to be more sensitive than the usual one with fulcrum pins.

For the Russian locomotives the cabs are hardly less convenient than those employed in America. The windows in the Warsaw engine are fairly deep, so that the engineman is not obliged to stand near to it to see all over the road in front.

A drop seat is fixed to the cab side for the fireman, and a saddle seat to the top of the driving wheel cover for the engineman. The reversing screw is similar to those for simple engines, a mere notched locking disk taking the place of a hand wheel. The engineman can stand on either side of the cab to work the throttle and this is effected by means of a joint in the throttle handle provided with a notched quadrant which permits the extended lever to be set at any desired angle to suit the convenience of the engineman.

ELECTRICAL PROBLEMS OF MAIN-LINE RAILWAY TRACTION.

By Charles T. Child.

The interest which characterised all of Mr. Child's writings is heightened in a peculiarly sad way in this case by his death, which occurred on June 23. The proofs had already had the advantage of his revision. The article—probably the last of Mr. Child's electrical writings to appear—exhibits markedly his happy characteristic of concise and lucid expression. It is remarkable as a comprehensive general statement of the conditions to be met in heavy railway service, and the sufficiency or insufficiency of present modes of electric traction to satisfy them.—THE EDITORS.

VER since the change of motive power from horses to electricity was accomplished upon the majority of city tramway lines, the public has felt the day for the electrical equipment of main-line railways to be close at at hand. With this belief no inconsiderable number of electrical and other engineers have agreed, but there seems to be no very wide-spread movement in railway circles towards the supersession of the locomotive. Indeed many, if not most, railway engineers still regard the general equipment of their lines with an electric-traction system as little short of chimerical—as a thing that may be interesting to talk about if no more serious subject of conversation is at hand; but only a few have gone so far as to look closely into the fascinating problems presented by the design of an electrical system. To give some account of these problems, with brief reference to what has been accomplished towards their solution, is the purpose of this paper.

The service of a tramway is all of one kind. The service of a railway is differentiated into two great classes, the transportation of freight and of passengers, and these classes are further subdivided, in accordance with local demands and the nature of the railway itself, into more or less numerous sub-classes distinguished by the composition, speed, and schedule of trains. For the different classes of trains and service different types of locomotives have been evolved, ranging all the way from many-wheeled slow-geared mountain-climbing and freight-hauling engines, to the high-drivered racers that compete for the prizes of speed records in express-passenger service.

On account of all this differentiation of classes of trains and service and of speeds and schedules, the motive-power requirements vary very greatly from train to train. Suburban passenger service, for example, requires that trains shall be sharply accelerated when leaving stations, in order to attain a high speed from end to end of their runs. Through express trains require high speeds to be maintained for long distances and considerable intervals of time, while rapid acceleration is not so important in their case. In these two classes of passenger service the weights of trains also differ widely, as they do in local and through freight service. In short, every train presents conditions determined by its speed and schedule which require its motive power, for the attainment of the highest efficiency, to be applied in amount and method differently from its application to other trains.

Whatever the nature of the motive power applied to the moving train, it must be under instant and perfect control, must be reversible, and must admit of continuous operation at all speeds between the highest desirable and the minimum needed while coupling cars, crossing switches, and in such other situations as require the lowest speeds. The nature of the power equipment should, of course, be such as to cause no increase in risk to the personnel of the railway or to property, or none that is not fully compensated in some way. And, naturally, the operating expenses of the railway must be reduced by any change in motive power, not necessarily as a total, but certainly reduced when measured against the ton-mile of goods transported or the passenger-miles traveled. Of course these statements are the merest truisms, but they are essential and fundamental to any discussion of the railway traction problem, and are all too frequently lost to sight by those who have looked upon electrical equipment of any sort and at any cost as the coming method of working railroads.

Having thus noted that the motive-power requirements of railways are of many sorts, and that they require conformity to certain simple fundamental engineering and financial principles in any novel undertaking, it is well to examine the present state of the art of electric traction to see what it offers and how best it may be made to serve the exigencies of railway operation.

Only two general methods of operating moving cars or trains by electric power have been devised. One of these, that utilizing a source of electrical energy carried on the train itself—a storage or primary battery—can be left out of consideration because of the commercial inefficiency of such apparatus for this purpose. Their depreciation-cost more than counterbalances any advantages they may possess.

The other method of operation is to distribute electrical energy along the right of way upon a fixed conducting structure, from which the train derives its power through a moving contact. This method of working, which has proved its entire practicability upon thousands of miles of street railways and light railroads, requires a different type of conducting structure and of distributing network according to whether direct or alternating current is used at the train motors, and whether or not the track rails are used as electrical conductors. The simplest case of an electrical power-supply system is that exemplified in the usual trolley road, where a constant difference of electrical potential is maintained between a fixed conductor parallel with the track and the track itself, direct current being used throughout. Perhaps the most complex case met in practice is that of a number of American long-distance interurban lines, where current is generated as three-phase alternating, stepped up in voltage for distribution, stepped down again at sub-stations, where it is also converted into direct current, and thence distributed to the conductor parallel with the tracks.

Of the two varieties of electric motors, those using direct and alternating currents, each possesses distinct advantages and as distinct limitations for railway service. The direct-current motor has very high initial torque or starting power, and through its use high acceleration can be had. Its construction presents no difficulties, and ample experience has been had with it under every variety of operative conditions. It can be made of large output for a given weight and its cost is comparatively low. Its mechanical strength is great and its depreciation in service small. It can be controlled and regulated with ease and certainty in several ways, and it lends itself admirably to the multiple-unit method of operation, by which each car of a train may carry its own motive-power equipment and all may be controlled from a single point, no matter how many cars are assembled to form a train. But with all these advantages it is handicapped severely by the inability of manufacturers to build it for high voltages of supply.

The present limit of safe practice in direct-current motors seems to be at about 700 or 800 volts—a pressure requiring a current flow of about one ampère for each horse power developed. With heavy trains and high speeds the problem of collecting the necessary large current becomes of almost insurmountable difficulty. Added to this is the equally difficult matter of supplying such volumes of current efficiently along an extended conducting system. Indeed, the limits of working with direct current are so sharply set by the energy loss and voltage drop in conductors that compromise system—that using al-

ternating-current generation and sub-stations—has already been forced upon a number of engineers as a make-shift. More than a make-shift this hybrid system can not justly be considered, since it involves an unnecessary cost for labor in operating the sub-stations and increases fixed charges out of all proportion.

The alternating-current motor is of several kinds, possessing differing characteristics. For railway uses the polyphase induction motor has already been employed in a number of notable installations. This type of motor has almost as many advantages as the direct-current machine. It is very simple, has no commutator, and possesses enough initial torque to start from rest any load it will work under. It is singularly enduring in service and has an almost negligible depreciation. While not quite so efficient (commercial types are under consideration) as the direct-current motor, it is sufficiently so. It is somewhat larger and heavier for the same output of power than the direct-current motor, but not to an objectionable degree. It can be made, and herein lies one of its largest claims for recognition, for practically any voltage that can be generated directly, or for pressures up to 12,000 or 15,000 volts in large motors. Coupled with these advantages, however, are the detrimental qualities of low power-factor, requiring line, dynamos, and motors to be built a substantial percentage larger than the requirements of the working power transmitted indicate, and difficulty of control.

To remedy the latter difficulty (the former is practically irremediable) recourse has been had to a number of devices and methods, some of them of high promise. The fact remains, however, that the regulation of the speed of induction motors is not yet satisfactory; they can be stopped, started, or run at half-speed when two are used together, but they can not be depended upon at present to pull a heavy freight train at three miles an hour across a temporary repair job in the track, or to back a train up gently to a waiting Pullman car.

But the alternating current has all the advantages, save one, when its distribution and generation are considered. Indeed, it is the only kind of current that can be satisfactorily and economically distributed along a hundred-mile section of railway, for example. The cost of generation is not essentially different whether the current output be alternating or direct, though alternating generators cost a little less than direct-current machines, both in their purchase and their upkeep. Once outside the power house, though, the cost of transmitting large powers by direct current, at the voltages imposed by the motors, is utterly beyond reason for long lines, and for short ones of heavy

traffic. The weight of conductor metals—copper, aluminium, or iron—that would convey with a given loss 1,000 horse power ten miles at 500 volts, will conduct the same power 200 miles at 10,000 volts with the same loss. The latter voltage is well within the limits of safe alternating-current practice.

But a very serious practical difficulty exists in using an alternating-current feeding system. Polyphase currents require at least three conductors for their transmission—that is, two conductors and the track, if the latter be used as part of the electrical circuit. The direct current requires only two conductors—or one conducting system, trolley wire, third rail, or whatever else may be used, and the track. The electrical system paralleling the track may be made electrically continuous and of one polarity in this case. If the track is not used as part of the circuit, then the conductors must be of two polarities with direct current and of three with alternating, unless some way of utilizing single-phase alternating currents is discovered. Just here the difficulty arises, since at every switch-point and crossing these different polarities would be brought together.

The third rail may be looked upon as a temporary device, sanctioned perhaps in certain extreme cases where nothing else will serve the purpose, but unsafe and inviting accidents and damage suits wherever put down. On absolutely restricted rights of way it may survive for a time; but on a main-line right of way it is impracticable. A shunting yard full of "live" third rails would be as dangerous as a battlefield.

A considerable number of sectional third-rail systems have been patented—some 400 of them in the United States Patent Office alone—but their use has been very limited. At best they are a costly compromise and probably as dangerous as the live rail, by virtue of their seeming safety which invites carelessness. Apparently the only safe and sure way to install a conducting system is to put it overhead, either immediately over the tracks or at one side of the right of way. Even with this construction there are bridges and tunnels to consider. If only it were possible to operate both direct- and alternating-current motors on the same train and track, so that the advantages of both might be secured, the problem would be very much easier. This has actually been suggested—most recently by Mr. James Swinburne—and a number of methods of accomplishing this apparently impossible result have been devised. In effect they consist of a sub-station on each train, alternating current being taken from the line conductors, where all its great advantages are preserved, and either by means of

transformers and rotary converters or of synchronous motors driving dynamos, converted into direct current for use on the motors. Terminal and suburban sections might be equipped only with direct-current feeders, so as to simplify the motor equipment of local trains and shunting locomotives. All this, while very interesting, would be more satisfactory to railway engineers if it had been tried long enough to give data of costs of operation and maintenance and, above all, of certainty of operation.

For, after all, the first duty of a railway power equipment is to move the trains in accordance with the schedule and with the degree of safety to which we are accustomed. It is a safe prediction that electrical equipment will not become general for main-line railways unless it accomplishes an increase in economy of working, or else, which amounts to much the same thing, increases the traffic possibilities of the line. The former improvement would be welcome everywhere; the latter would be of little use to railroads, of a type common in the United States and in many other countries, that have less traffic than can already be handled on a single track.

The first place for electrical equipment on main lines is on suburban sections, for the handling of heavy passenger traffic. Here the superiority of electric traction is already manifest and here, doubtless, will be the theatre of experiments in which the best variety of conducting equipment, of rolling stock, and of electrical apparatus will be discovered and standardized. The advantages to be gained by small diminutions in the motive-power costs are not so large as are commonly thought. In America the labor costs for railroad operation are about twice as large as all the other costs combined, including motive-power, administrative, and maintenance costs, and only a large saving in motive power expense would make much of a showing in the totals. Naturally the whole problem of costs is incapable of generalization, since conditions differ widely amongst different railroads. Questions of cheap water power and dear fuel, of strictures upon the stream of traffic interposed by natural obstacles, such as sections of heavy grades, and the like, make the solution different in each case. Undoubtedly electricity will play an increasing part in railway traction, but the present equipment of locomotives on most railways will probably be worn out in service—unless the induction motor can be brought under more perfect control. If that happens—and there is no safety in the word "impossible" in electrical engineering—we may expect to see important changes. As the problem stands today, however, the solution is certainly not apparent.

SOME UNACKNOWLEDGED CONDITIONS IN BRITISH WORKSHOPS.

By T. Good.

Mr. Good's assertions are startling, but any pains-taking investigator who will direct his inquiries carefully will soon come upon ample proof of every count in the indictment. Of the confirmation secured by the Magazine before publishing this article we shall have more to say at another time. It is enough now to say that it is astonishing in its completeness and its authority. But we are by no means disposed to think the evil is more than sporadic. It is not an "institution," either national or of trades-unionism, that Mr. Good attacks; it is an abuse, injurious to both employer and workman, to be found, in America as well as in England, where a lack of conscientious purpose in the subordinate officials co-exists with lack of discipline in the controlling officials, or owners. Its inevitable result is degradation of the workmen and decadence of the establishment. Our purpose will be served if attention is directed to the possibilities of evil which lie in the system Mr. Good exposes, and the interest of manufacturers is so awakened that they will prevent its gaining or keeping any foothold in their works.—The Editors.

NOW that there appears to be real cause for alarm concerning the British industrial position we are hearing a good deal of what is known as the "Ca'canny" policy, and its injurious effects are being pretty clearly demonstrated. As one who has been able to study this problem on the spot I beg leave to disagree with much that is written upon the subject by those whose knowledge of workshop methods is necessarily limited. That this "Ca'canny" policy is in extensive operation in many industries, that it has a demoralising influence upon workmen, and that it materially affects the larger problem of foreign competition, I freely admit; and that this foreign competition question is to the worker a wage question, to the employer a profit question, to the landlord a rent question, and to the entire community a national question imperatively

demanding the strictest attention, I fully recognise; but, because I have had the advantage—or, perhaps, disadvantage—of practical and personal experience in workshop government, have witnessed some of the evils thereof in their naked deformity, have carefully traced them to their natural sources, and, having been behind the scenes, have arrived at conclusions not in accordance with those generally accepted, I claim indulgence to put part, at least, of the blame upon the right shoulders.

By universal admission, the great stimulus needed in the British industrial system is some method by which men shall be paid, or promoted, according to individual ability, and every man encouraged to do his best. A dead level of mediocrity is incompatible with a progressive industrialism. How is efficiency to be cultivated in the national interest, and rewarded in the individual? In the first place, what prevents the free development of individual ability and energy today, in British workshops? In a word, why do men who have sold so many hours, or days, of their lives to an employer, "go-easy"?

There are many reasons. The cardinal fault is this:—under present conditions a good clever workman (and there are many of them, even in Britain) is in too many cases valued by his employer no more than a bad one, simply because the employer is unaware of his superior abilities. The management of all large establishments is in the hands of managers and foremen who are seldom shareholders in the undertakings, with the result that favouritism frequently plays havoc with the employer's interest. Managers are often appointed through social influences, rather than by merit or fitness for posts of trust; foremen are selected because they are favourites with the manager; and chargemen, or gangers, are selected because they are favourites with the foreman. At least ninety per cent. of the workshop promotions that have come under my personal notice have been bestowed upon men other than those best fitted for the honours. And the consequences have been, and are, simply deplorable, for under such a system men lose all incentive to put forth their best energies, and honest work and genuine ability are placed at a discount. It is a sorry admission, but I must say that my varied experience has convinced me beyond the shadow of a doubt that honest workmanship seldom pays.

Under conditions at present existing in many workshops—and here I would urge those who shed tears of ink over the British workman's indolence to mark well what I say—the man who gets on the best, who is favoured by the cleanest and most comfortable jobs, who maintains his employment when others are dismissed through temporary slackness, and who is singled out for promotion, is he who regularly attends

either the same place of worship or the same public-house as his foreman, and it by no means follows as a corollary that this is the best man in the shop; in fact, the reverse is usually the case. The result under these circumstances is that men who have secured positions of trust in a workshop through dishonourable means are not too self-respecting to receive bribery in the shape of "tips" and "treats" from some of those workmen under their authority, to the detriment alike of honest labour and capital. When I say that this pernicious system of bribery is a very powerful factor in the industrial problem—a very real and great evil in every-day operation—and is largely responsible for a chronic form of "Ca'cannyism," I only say what I know to be true. I could quote a case where a firm employing about five thousand men were rendered bankrupt, their plant and machinery laid idle, and the whole district in which the works were situated thrown into industrial chaos, through this very system, which was carried on glaringly for many years, until at length the crash came—capital and labour suffering indiscriminately.

I have seen methods of bribery at work in some shops to an extent positively appalling. In such cases, few men who failed regularly to tip or treat their foreman stood any chance of either promotion or constant employment. Time after time I have known good, efficient, and honest workmen dismissed when trade has been a little slack, whilst the services of drunken, unprincipled, good-for-nothings have been retained, the employer thinking, quite naturally, that his trusted subordinate official could be relied upon to weed out the most undesirable men only. Knowing what I do of "workshop politics," the wonder to me is that British workers, man for man, perform as much honest work as they do, so seldom is a good, capable workman encouraged. With all due respect to those managers and foremen who are honourable men, I do not hesitate to say that speaking generally, present-day methods of workshop management constitute a national disgrace! I have known men who were managers' favourites to charge their employer, day after day, for overtime that was not worked. To my knowledge men have drawn their full wages, with overtime rates added, for doing absolutely nothing for their employer, but a portion of the money has been handed to the manager. Cases have come under my notice of men drawing full-time weekly wages from one firm, whilst at the same time they have been earning money elsewhere, having been enabled to do this through a fraudulent system of time-keeping, although from the same works good honest men have been dismissed for losing two "quarters" during one week.

Besides tipping and treating, there are other forms of workshop bribery which I deem it my duty as a Briton, anxious for the welfare of my country, to expose. One method by which a premium is put upon dishonesty is a system of trading carried on by managers and foremen with their workmen. Many managers of works accept commission agencies from furniture dealers, clothiers, jewellers, and others for the supply of goods on the credit system to workmen. Under such a manager, all the lazy, inefficient man has to do in order to keep his employment, whether trade is good or bad, and to get paid for a liberal amount of overtime, is to patronise the shop-keeper whom his manager nominates. There are many managers and foremen in Britain who draw more money from shop-keepers in the shape of commission, than they draw in salaries or wages from their employers. Where such foremen are in power, the honest and dignified workman who will not stoop to such despicable means of gaining favour, but insists on buying for ready cash in the cheapest market, is put on all the dirtiest and most unpleasant jobs, and got rid of as speedily as possible. Whenever I find a man employed uninterruptedly for a great number of years in a large shop where other men are being constantly suspended, or dismissed, I am suspicious of that man's ability and integrity.

Another industrial evil that places honest skill and faithful service at a discount, and that has come under my personal observation, is money-lending. Frequently, foremen advance small sums of money to men under their charge, and receive good interest in return—usually two pence in the shilling. It naturally follows that the drunken spendthrift—seldom a capable workman—who is always in debt from Monday to Saturday, is unduly favoured at the expense alike of honest labour and capital. I have known men of this stamp who for months together have never been at work before breakfast, but they have, nevertheless, drawn full wages all the time, with the knowledge and consent of their foreman. Other cases I have in mind where men under dishonest foremen have enjoyed full wages without rendering an iota of service to the firm paying the wages; they have simply held sinecures. Men thus favoured have, of course, served their foreman in some way—perhaps by a little gardening, or by assisting in a shop when the foreman has been a shop-keeper, or by their wives or daughters doing a little domestic work gratis. Need I expose these methods of bribery any further?

Under these conditions, which are far more prevalent than any writer or speaker upon industrial problems who has not had the benefit of practical experience in workshop methods has any idea of, and

which I am endeavouring, without sensationalism, to make plain, can we wonder that Britain, as a nation, appears to be lagging behind some of her competitors?

Now there is another point in connection with the labour question to which I wish to draw attention; and here I must say a word in defense of the middle-aged, or elderly, workman, which will not be very complimentary to the young men. There is a tendency on the part of many employers to discard middle-aged or elderly workmen, and give preference to young men, especially since the passing of that legal monstrosity, the Workman's Compensation Act. In many industries men over forty years of age are out of the running for a job, whilst some employers even refuse to take on men who are over thirty. This I regard as a mistaken policy. After careful observation I am convinced that the man of forty or fifty years of age is of far more value than the young blood of twenty. The elderly or middle-aged workman goes about his task, as a rule, methodically, continuously, carefully, and with due regard to the safety of life, limb, and property. But this is not the case with the average youth or very young man; he does his work more often by fits and starts, and is careless alike of the safety of his fellow-workmen, and his employer's property. He cannot, owing to lack of experience, exercise the judgment and caution of an older and more skilful man. If he has to rig a stage, scaffolding, or gangway, he has not the experience of the elderly man to guide him to the safe completion of his labour. I have stood near the gates of large works when it has been the time for setting on workmen, and it has pained me to see the youth of twenty called in, whilst the man of forty, a householder and the head of a family, has been turned adrift. This policy is economically unsound, and morally wrong. Our young men of to-day, if we are to hold our own in the commercial race, need less work, but more *education.*

The greatest fault in the British industrial system, at least so far as methods of workshop management are concerned, is the wideness of the gulf between the employer and the man who uses the tools. Why should the employer, or managing director, consider it *infra dig.* to be personally acquainted with the man at the bench? If employers could, or would, take a little more interest in their men, take a little more cognizance of the human nature that is at work in their establishments, and place a little less reliance in their subordinate officials, there would soon be a marked change for the better in workshop life; but so long as employers place absolute confidence in managers and foremen who are seldom shareholders in their business; so long as it is possible for

the unprincipled loafer, the wasteful and inefficient scamp, to be as well treated as the good, clever and dignified worker, or even better treated —so long will "Ca'canny" be an industrial epidemic. I would strongly urge upon employers the importance of realising that men are not machines and that the British workman, at any rate, can be more easily led than driven. My point is this:—an employer may have a hundred machines all of equal capacity and value, but out of a hundred men he has no two alike, and very often the man who suits the foreman the best, serves his employer the worst. I would advise employers to ascertain for themselves, as far as it is possible, who really are the best men in their shops, and to reward them accordingly. I would like to see a round-table conference of representatives of the employers' federations and the workmens' unions and to have this question of individual merit thoroughly discussed. I am sure a good understanding might be arrived at, and some practical scheme adopted whereby ability, honesty, and dignity would be cultivated. Britain has reached a period in her industrial life when it is necessary for her to examine her ailments and deformities, and to apply remedies that will make her a healthy nation—industrially, commercially, and morally.

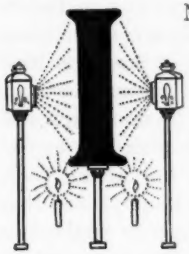
By the foregoing I do not wish it to be inferred that I regard the "Ca'canny" policy as the only drawback to a healthy and progressive industrialism. There are evils far greater and more deep-rooted in British methods of production and modes of business than this slackness on the part of the workers—evils that clog the wheels of industry at almost every turn; evils that are rapidly rendering the whole of the British industrial system obselete, and undermining the very foundations of Britain's greatness. These faults and failings, these antiquated methods and artificial restrictions, which have been borne tolerably well hitherto, but which are approaching a prohibitive point now that some of Britain's erstwhile customers are manufacturing for themselves—these industrial drawbacks will have to be exposed in the very near future as the "Ca'canny" policy is now being brought to light, and drastic remedial measures adopted if Britain is to maintain her supremacy, or even a respectable position, in the world of trade and commerce. But these subjects do not come within the province of this article, which is simply an unvarnished statement of facts—evidence of an eye-witness—upon a subject of public importance, and one that must be taken into consideration in connection with the larger problem of foreign competition.

ACCURACY AND VALUE IN THE TESTING OF CAST IRON.

By Dr. Richard Moldenke.

Dr. Moldenke, in the article below, comments upon and in a measure dissents from the methods of testing advocated by Mr. Buchanan in our May issue. Both join in advocating the "test to destruction" of a specified selection of the castings, as the completely satisfactory method wherever the test to destruction is possible to apply. Both recognize the same variables—casting temeperature, rate of cooling, etc.—as causes of difficulty in getting a bar to represent the casting fairly when test-bar indications must be relied on. It is upon the resultant mode of procedure that they differ. Mr. Buchanan would associate the test piece so closely with the casting it is to represent that it should be subject as nearly as possible to the same conditions, of every sort, and therefore should have the same chemical and physical constitution and actually indicate the kind of iron in the casting. Dr. Moldenke would discard this policy as inadvisable, cast the test bar separately under conditions as nearly ideal as practicable, and thus make it represent the maximum possibilities of the iron in the ladle. He would then rely on knowledge and control of the variable influences to insure equally good results in the casting itself, and on separate foundry inspection to assure the buyer that these conditions were observed.

The foundry has been often referred to in these pages as the proper starting point of economy in most engineering works. In this view Mr. Buchanan's article and Dr. Moldenke's will serve as introduction to an important series on foundry management soon to follow.—THE EDITORS.



IN the May number of THE ENGINEERING MAGAZINE there appeared a very interesting article written by Mr. Robert Buchanan, in which he ventilates the test-bar question from the English standpoint. Toward the end of this article mention is made of the specifications for testing cast iron recently adopted by the American Foundrymen's Association, and it is pointed out that the results obtained by their use can only be misleading as to the character and quality of the castings represented.

I happened to be the chairman of the committee entrusted with this rather large undertaking, and I cordially welcome Mr. Buchanan's criticisms, and at the same time thank the management of THE ENGINEERING MAGAZINE for the opportunity afforded to present the American view of the situation, showing why these specifications, now generally recognized as the fairest and simplest solution of a complex problem, were made to include the testing of bars; why these were given the shape, and were made in the way specified.

In America we recognize the fact that the only true way to test castings is to do so "to destruction." Our whole buying practice is based upon this wherever possible. Pipe, car wheels, couplers, fit-

tings, are some of the castings which are generally accepted only on a test to destruction of a specified number from a given lot. Other classes of castings, such as rolls, gears, and ingot moulds, have guarantees attached which amount to tests to destruction; for if the castings fail to come up to the guarantees, the maker is given an opportunity to remove his material from the premises of the buyer.

The small castings bought on tests to destruction are legion; because, however, they are nearly always bought by private contract, the specifications are seldom heard of by others than those interested. I have been for many years in contact with these things, and am satisfied that where this is really a possibility, the testing to destruction in the case of those castings will come about just as quickly as the necessary knowledge of the characteristics of cast iron becomes common property. Paragraph three of the specifications adopted by the American Foundrymen's Association states that "when the castings themselves are to be tested to destruction, the number selected from a given lot, and the tests they shall be subjected to, are made a matter of special agreement between founder and purchaser."

It is further a recognized fact that only a small portion of the world's production of castings can be tested to destruction. By far the greater quantity does not lend itself readily to this method of judging value. Witness an engine bed-plate, a fly-wheel, or other casting the strength of which it is quite essential to know at least approximately. The system recommended in Mr. Buchanan's article, that of attaching coupons to the work and testing these, though still in use here in government and cylinder work, is, according to our best-informed American foundrymen, happily on the wane. Such directly attached coupons suffer more or less from the very fact that they are thus connected, and may sometimes be severely strained in the cooling, not to speak of inaccuracies resulting from temperature variations, as may be seen from Mr. Buchanan's results. To compare such coupons with the castings they are supposed to represent, especially where the bars are cast flat, and would give different results tested cope-side-up from cope-side-down, and where they are rectangular in section, would certainly be misleading, in the light of our most recent knowledge of cast iron.

When we consider that there are so many variables connected with the making of iron castings, there is little wonder that the task of obtaining a test bar which will represent a casting properly seems hopeless. American foundry thought, at least as represented by the most progressive element in the actual production of castings, found

its expression through the work of the American Foundrymen's Association, in the decision that, apart from the testing of castings to destruction, it is necessary to cut loose from the idea of judging the merits of a casting from a bar supposed to represent it. What is really wanted is a method which would confine itself to the proper and accurate representation of the kind of iron going into the casting. What the iron becomes when in the casting depends upon the conditions prevailing at the time, and the skill of the founder in regulating them to obtain the effect desired. This decision at once put the matter into an entirely different light. The iron is now to be given the best possible chance, not to be made artificially strong, for the sizes adopted (diameters of 1½ inches, 2 inches, and 2½ inches) are sufficiently large to preclude this by wiping out the effect of green and dry sand moulds, and moderate variations of the pouring temperature. The softest irons have the smallest diameter quoted above, the cylinder and heavy castings the medium, and the chilling irons the largest diameter bar. The round cross-section was selected to avoid the weakness caused by intersecting planes of crystallization.

Test bars are to be cast on end, to remove the errors incident to casting them flat. The slightly higher combined carbon found at the bottom of a bar cast flat makes it stronger when tested in the position in which it was cast, the lower side being in tension under a transverse strain. Were the bar reversed, the softer upper side, as cast, would be in tension in being forced downward, and a lighter weight would cause rupture. It is true that a bar cast on end is more difficult to make, but after all, this means only a little practice on the part of the molder.

The bars are specified to be short, the transverse test being made with supports 12 inches apart, for investigation has shown that with the lengthening of the test bar the value of a transverse test, especially for resilience, is greatly diminished. In this particular we differ radically from Continental practice, where very long bars are the rule. The tensile test for cast iron, though provided for, is not to be specially recommended; on the other hand, we would welcome properly applied impact tests. What we want are easily made, simple bars, to work with in our daily shop tests. What better system, beyond the tests to destruction, can be devised, than one which enables the manufacturer to invite the purchaser, or his inspector, to make the foundry his home for awhile; to observe the processes as carried out; the bars, which should fairly indicate the quality of the metal poured into the castings, tested; and to have constant access to the labora-

tory records, nothing either good or bad being concealed? Let the purchaser break the castings rejected for surface blemishes, and thus receive the assurance that the iron has received proper treatment after leaving the ladle. Ten chances to one, he will feel safer when using the castings than if he had tested a coupon attached to a piece of metal perhaps 2 feet thick. Iron which shows excellent qualities when put into a 1½ inch diameter bar, and cast under the most uniformly fair conditions possible, will be safe to go into important work. If, on the other hand, the test shows doubtful iron, no risks should be taken.

In the pamphlet issued by the American Foundrymen's Association on the subject of testing cast iron, complete instructions as to the best method of molding up these bars are also given. These were the work of the veteran foundryman, Mr. Thos. D. West, and this will account for the universal acceptance of their value.

I was fortunate enough to participate in the recent Congress of the International Association for testing materials, held at Budapesth, and was agreeably surprised at the general interest shown when the subject of testing cast iron was brought up for discussion. The American members present fought valiantly for the recognition of cast iron as a material requiring our most earnest study, and succeeded so well that special steps were taken to adopt ultimately specifications for quality requirements in this branch of the iron industry. Our American Association for Testing Materials is now engaged in looking over the ground, and "tests to destruction" will form a point to be strongly dwelt upon.

We will welcome our English and Continental friends in helping us clear away the difficulties encountered in the path of true progress, and most earnestly hope that the ultimate result will be to put the foundry product on a more exact basis for properly judging its value.

THE ECONOMY OF MECHANICAL STOKING.

By William Wallace Christie.

In Mr. Christie's previous article the structural and operative features of the principal mechanical stokers were described, the fundamental principles upon which the construction of modern successful stokers is based being discussed. The present paper, concluding the subject, considers the general economy of mechanical firing, based upon data obtained from the operation of various existing installations, and thus free from the uncertainty attending conclusions founded upon theory alone.—THE EDITORS.

THE operative advantages to be expected from the substitution of mechanical stoking for hand firing may be enumerated as:—lower cost of firing, greater uniformity in condition of fires and operation, readiness for burning all grades of fuel, and less production of smoke.

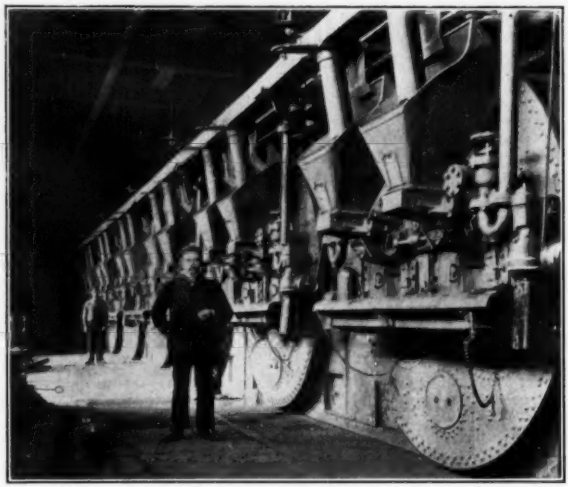
Considering the lower cost of firing, it must be realized that much harder firing is now required than was formerly necessary. From a desire to get the greatest possible financial return out of a given plant, the rate of combustion has been increased until the maximum quantity possible of poor fuel per square foot of grate per hour has been burned. This has been followed by the use of free-burning grades of bituminous coal, giving a still higher rate of combustion, until the work required of firemen has become excessive both in amount and in cost. A full day's work for an able fireman is the shoveling of not more than 10 tons of coal in 12 hours, or about sufficient for 450 boiler horse power. If the same man is required to handle coal into hoppers for mechanical stokers, he could take care of two units of 500 horse power each, while if the coal was fed into the hoppers automatically he could take care of four such units, or 2,000 horse power.

The cost of labor would thus be reduced in the proportion of 450 to 2,000, or about three-fourths, one man being able to do the work formerly requiring four. The time required for cleaning a fire under a mechanically fired boiler is also said to be less than one-tenth that needed for similar work with hand-fired furnaces.

Uniformity in condition of fires is doubtless best secured by the continuous processes of automatic firing, and it is undoubtedly true that mechanical stokers give the best results with a fairly uniform rate of combustion, involving a regular thickness of fire and a uniform pull of chimney draft.

Considering the ability to use any kind of fuel, it must be admitted that a mechanical stoker is a most desirable addition to many power plants where very low grades of fuel are burned, and where labor conditions sometimes compel sudden changes in the character of fuel supplied. The varied character of coals used for steaming is well shown by the classification of Prof. Humboldt Sexton.

Kind of coal.	Carbon, per cent.	Hydrogen, per cent.	Oxygen, per cent.
Non-caking Coal—Long flame	75-80	5.5-4.5	19.5-15.0
Gas Coal	80-85	5.8-5.0	14.2-10.0
Furnace Coal	85-89	5.5-5.0	11.0- 5.3
Coking "	88-91	5.5-4.5	6.0- 5.3
Anthracite "	90-93	4.5-4.0	5.5- 3.0



AN INSTALLATION OF BENNIS STOKERS FITTED TO INTERNALLY FIRED BOILERS.

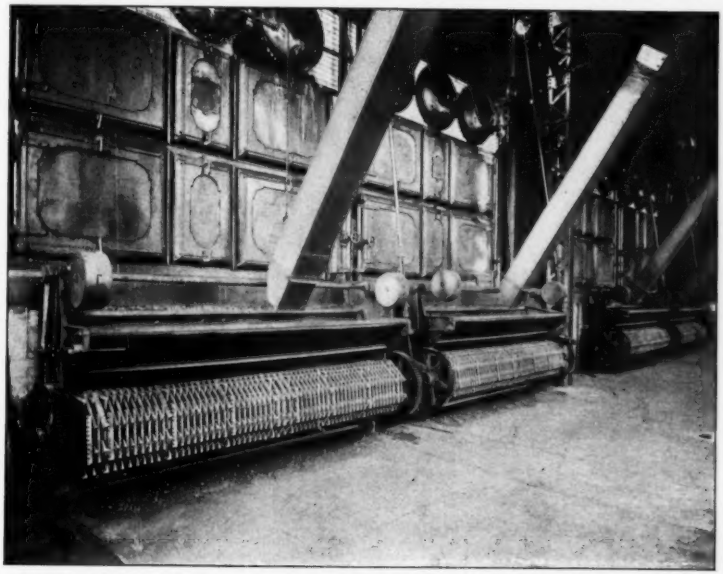
M. Gruner* in his "Metallurgy" gives a classification of coals in which he uses the length of the flame as an index.

	Per cent. Residue of Coke.	Volatile matter.	Specific gravity.	Calorific value B. T. U.
1. Lignite	30-45	70-55	1.15-1.20	12600-14400
2. Long Flame	50-60	50-40	1.25	14760-14400
3. Bituminous Long Flame	60-68	40-32	1.28-1.30	15300-15840
4. " Ordinary "	68.74	32.26	1.30	15840-16740
5. " Short "	74.82	26-18	1.30-1.35	16740-17280
6. Nearly Anthracite	82-90	18-10	1.35-1.40	17100-16560
7. Anthracite	90-95	10- 5	1.40 and above	16560-16200

The above tables may be termed "chemical" from the character of the information that they supply.

* Bertin & Robertson—p. 47.

Along practical every-day lines we have a table which was given by Mr. McClave of Scranton, Pa., in a paper read by him before the Anthracite Coal Operators' Association, January 9, 1896, which table gives the relative values of anthracite and bituminous coals when used

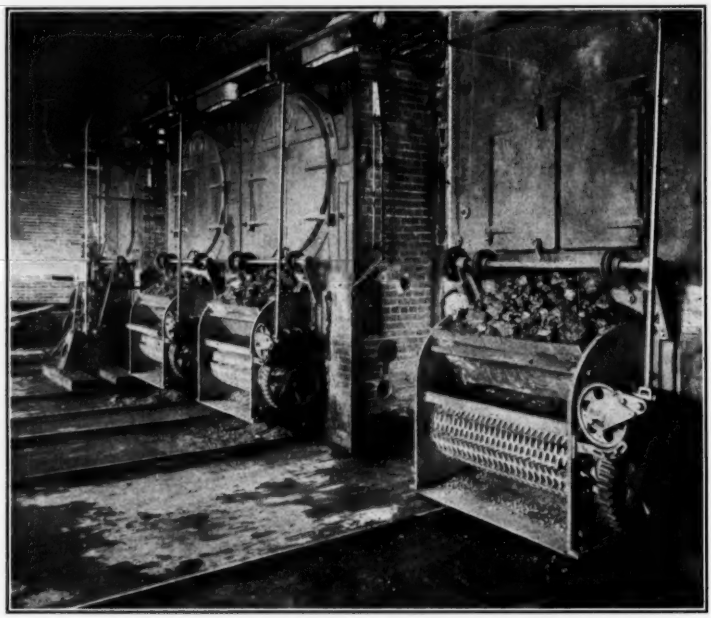


TRAVELING LINK GRATES, KAW RIVER POWER HOUSE OF THE METROPOLITAN STREET RAILWAY, KANSAS CITY, MO.
Green Engineering Co., Chicago, Ill.

for the purpose of steam raising; the last column gives the per cent. of additional weight of the various grades that must be burned to equal in fuel value the best anthracite and bituminous coals.

Kind of Coal.	Per cent. Value.	Per cent. To add.
Bituminous coal, good quality	100	
Bituminous slack, " "	90	11.1
Anthracite, steamboat, good quality	95	5.3
" broken " "	97	3.
" egg " "	100	
" stove " "	100	
" chestnut " "	100	
" pea " " well cleaned	95	5.3
" " mixed with bone slate	90	11.1
" buckwheat, No. 1, good quality	93	7.5
" " " 2, " "	85	17.6
" " " 3, " "	83	20.5
" culm, mixed with 20 per cent. soft slack, good quality	83	20.5
" No. 2 " " " " " " " "	77	29.9
" " 1 alone, good quality	75	33.3
" " 2 " " "	70	42.9

Diminished production of smoke is a necessary result of uniform firing, and so far as this condition is complied with the mechanical stoker may be regarded as a means toward the abatement of the smoke nuisance. At the same time it must be understood that smoke production is a result of imperfect combustion, and that mechanical

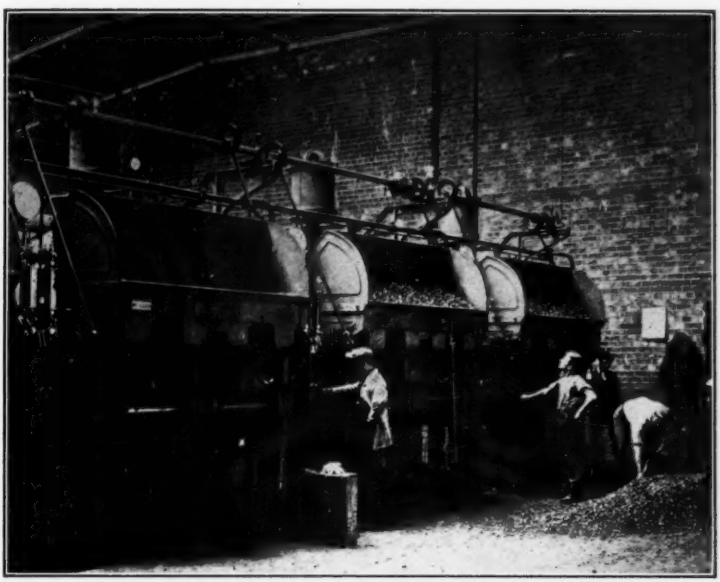


AN INSTALLATION IN THE BOILER PLANT OF THE SUPERIOR SHIP-BUILDING CO., WEST SUPERIOR, WIS., BURNING RUN-OF-MINE COAL.

Duluth Stoker Co., Duluth, Minn.

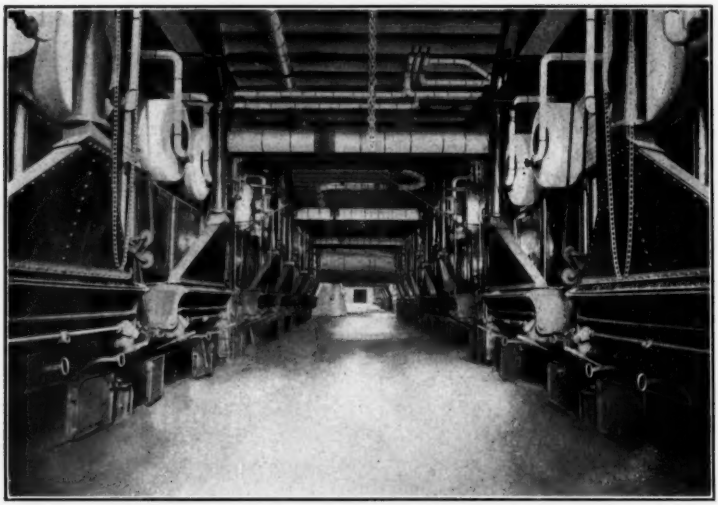
stokers are not smokeless when hard pushed. In this connection it may be noted that the evaporative power of a boiler is not materially influenced by the admission of surplus air, as will be shown by the following table:

Absolute Steam Pressure, lbs. sq. inch.	Evaporative Power in a Perfect Boiler as from and at 212° F. Air 1.	Air 1½.	Air 2.
14.7	15.67	15.46	15.24
30	15.56	15.29	15.02
50	15.48	15.16	14.85
75	15.4	15.05	14.70
100	15.34	14.96	14.58
150	15.26	14.84	14.42
200	15.19	14.73	14.28
250	15.13	14.65	14.17

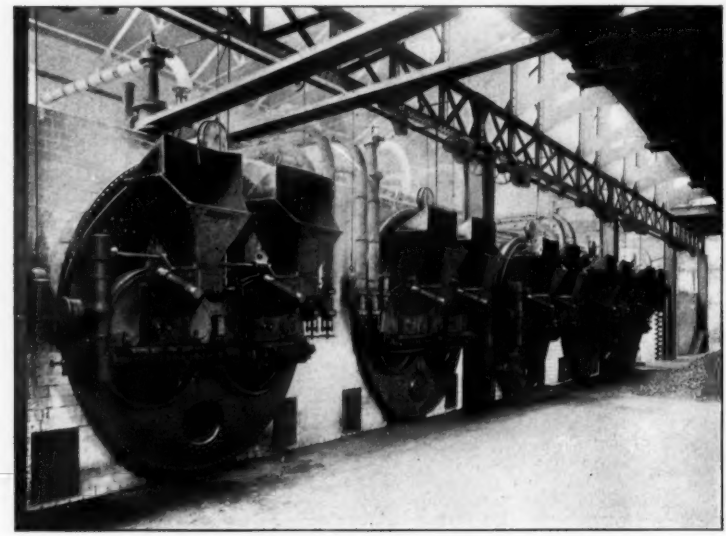


VICARS' STOKERS APPLIED TO LANCASHIRE BOILERS, POWER STATION OF THE HULL CORPORATION TRAMWAYS.

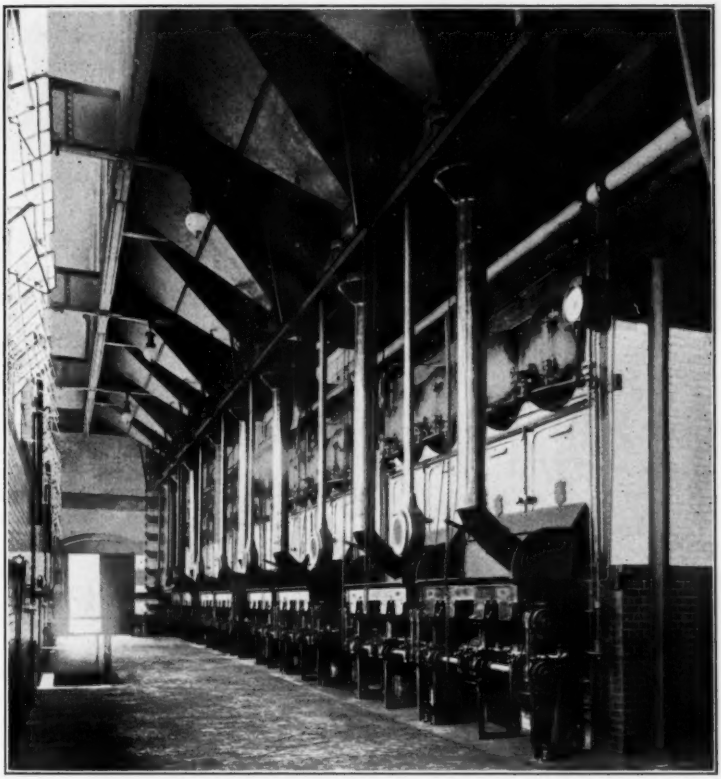
MECHANICAL-STOKER INSTALLATION AT THE PLANT OF BAUSCH & LOMB CO., ROCHESTER, N. Y.
The Underfeed Stoker Co. of America.



RONEY MECHANICAL STOKERS, 96TH STREET POWER HOUSE, METROPOLITAN TRACTION CO., N. Y.
Westinghouse, Church, Kerr & Co., N. Y.



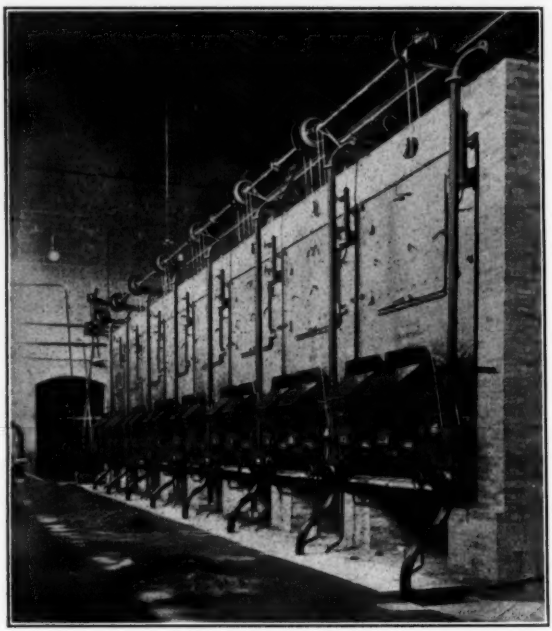
INSTALLATION OF TRIUMPH STOKERS AT THE NEW CORPORATION ELECTRICITY-SUPPLY STATION, HYLTON ROAD, SUNDERLAND, DURHAM.
Triumph Stoker, Limited, Ransomes & Rapier, London and Ipswich.



VICARS' STOKERS IN A LARGE LONDON POWER STATION.
T. & T. Vicars, Earleston, Lancs.

The influence of the mechanical stoker upon boiler efficiency has been discussed, but definite information is not readily obtained, although general opinions as to the advantages of mechanical stoking are numerous. The efficiency of a boiler, and consequently of a group of boilers, depends upon several independent and distinct factors. Thus we have the furnace efficiency, a measure of the completeness of the combustion in the furnace; this is measured by the ratio of the temperature in the furnace to the temperature of the escaping gases. We have also the efficiency of the boiler proper, measured by the quantity of heat transmitted to the water compared with that generated in the furnace. There are also two other kinds of efficiencies—

one the heat efficiency per pound of fuel, the other the so-called "investment efficiency," which takes into account the cost of buildings, apparatus, boilers, chimneys, wages, fuel, etc. Any statement of the efficiency of a stoker or other boiler apparatus should be accompanied with such data as will enable its relation to these various standard efficiencies to be determined, otherwise comparison will be difficult, if not misleading. Probably the grate itself may be found to be the best pulse from which to deduce the ability of a boiler to make steam, especially as it has a positive value when we know the character of coal to be burned and the draft to be had.

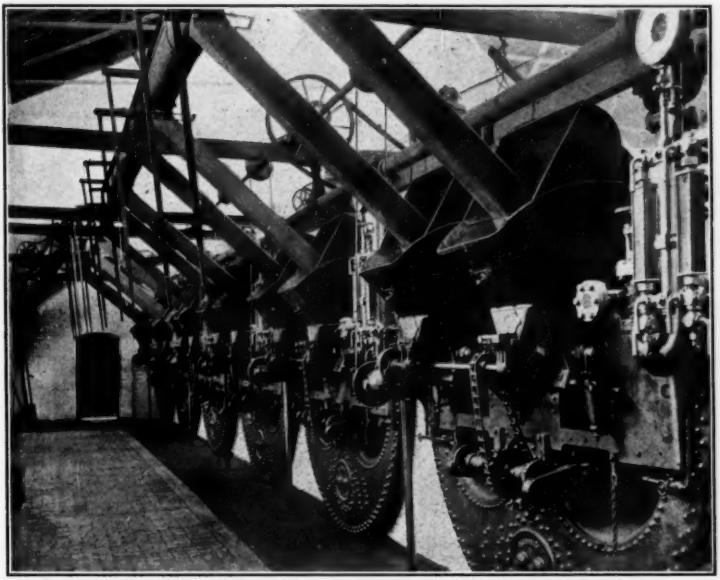


BENNIS STOKER PLANT FITTED TO EIGHT WATER-TUBE BOILERS AT A SUGAR FACTORY NEAR BARCELONA, SPAIN.

Bennis Lancashire Stoker Works, Bolton.

It has been maintained that the most economical rate for boiler operation is that of an evaporation of 4 pounds of steam per hour per square foot of heating surface, and certain boiler tests may be cited to show this. Other tests, however, show that the evaporation per square foot of heating surface may vary while the steam economy

remains constant. Thus six tests on an internally-fired multitubular boiler with corrugated firebox, with ordinary hand firing, show that at rates of combustion varying from 21 to 32 pounds of coal per square foot of grate per hour, the equivalent evaporation from and at

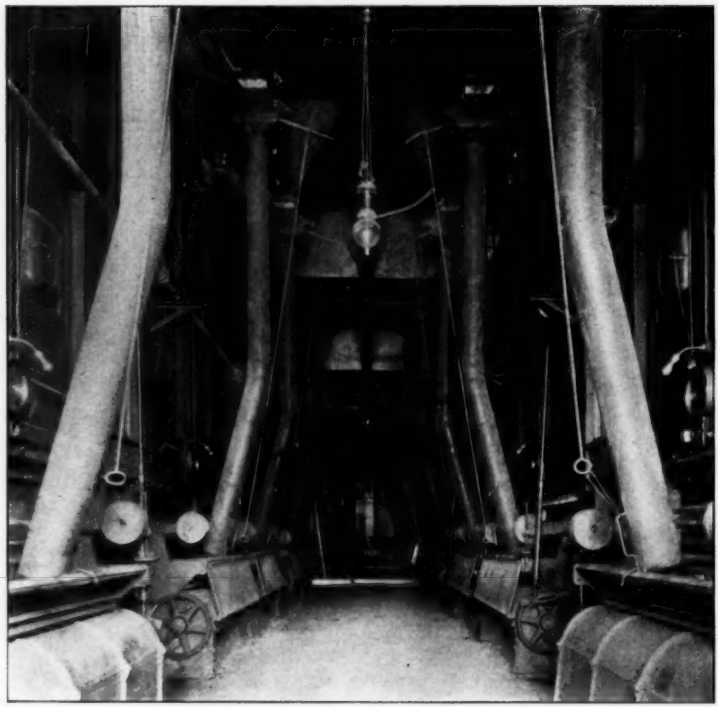


PROCTOR'S SHOVEL STOKER APPLIED TO FOUR EIGHT-FOOT LANCASHIRE BOILERS, NEW HYDRAULIC STATION OF NORTHEASTERN RAILWAY, MIDDLESBORO.

The stokers are fitted with a complete coal-handling plant, delivering coal automatically to the stoker hoppers by elevators and conveyors. Proctor, Burnley, Lancs.

212 degrees F. per pound of combustible remained constant, while the rate of evaporation per square foot of heating surface varied from 3 to 4 pounds.

The completeness of combustion can be told best by the temperature of the escaping gases and by an analysis of their chemical composition. Thus for excellent combustion the temperature of the discharged gases should not be higher than 400 to 500 degrees F. If the percentage of oxygen is 1.5 to 2 per cent., it indicates that the fires are too thick and the rate of combustion too high for the draft employed. If the oxygen exceeds 8 per cent., the fires are too thin, the draft too heavy, or too much cold air is entering the furnace above the fire. If there is an excess of CO and of O, the boiler is faulty in design, and good results cannot be expected. The quantity of air fed



CREEN TRAVELING-LINK GRATES, BOILER ROOM OF THE UNION TRACTION COMPANY, CHICAGO.

to the fire also influences the economy of the boiler to a limited extent, as shown on page 720.*

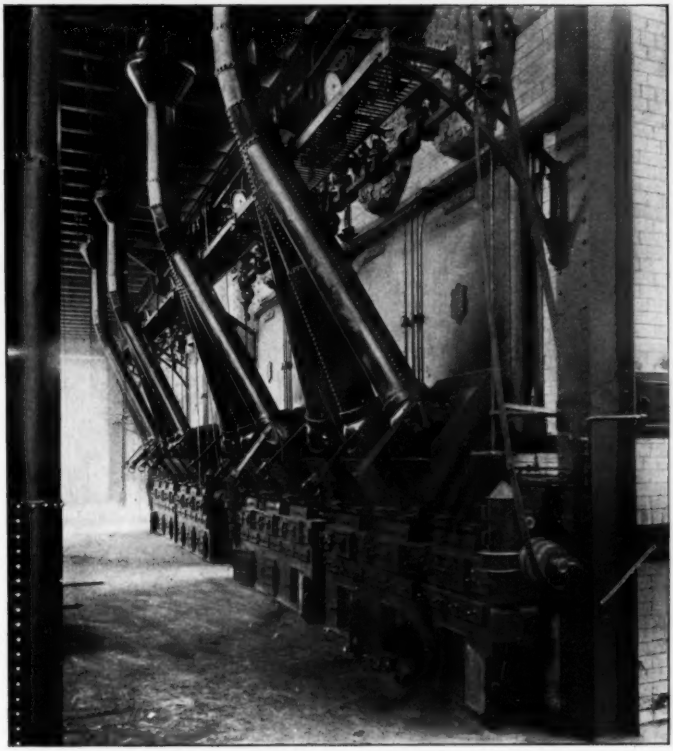
When steam is used under the grates to assist the draft and prevent the coal from clinkering badly, as it is in some stokers of the over-feed type, the steam, at the high temperature of the furnace, becomes dissociated into the separate elements H and O, and in the process takes up about 10,000 B. T. U. for every pound of steam so used. This heat is given back again in the process of combustion in the combustion chamber, or later, where the heat produced may be more efficiently absorbed. This fact may furnish a possible reason for the comparatively high economy of a well-regulated steam-blower draft in connection with a mechanical stoker.

* See also THE ENGINEERING MAGAZINE, April, 1901. Article by W. W. Christie.

Nowhere has hand stoking been more onerous than on shipboard, but thus far mechanical stokers have not been successfully installed. Bertin says:

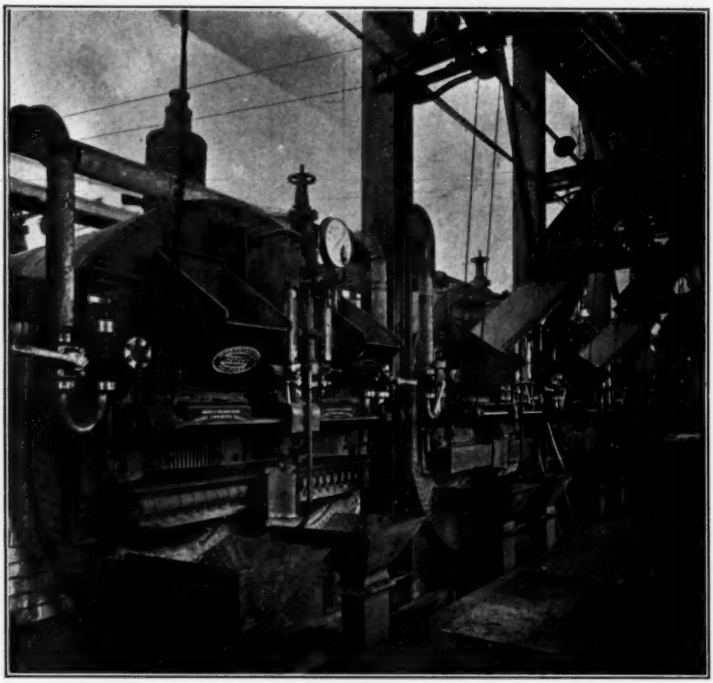
"Numerous attempts have been made to introduce mechanical stoking, with the object of getting a more regular combustion than is possible even with the most methodical hand stoking, and to obviate the heavy work entailed upon the stokers. The most ingenious system amongst the many tried in the French navy was that where the grate was composed of a number of endless chains, known as the Galle system. Chains were placed close together and kept in movement, the coal was distributed evenly over the bars at the furnace door end, and arrived at the bridge completely burned. The cleaning of the fires was also done automatically.

"After repeated trials at sea all the various systems of mechanical stoking have had to be abandoned, and the human stoker with his shovel and rake again installed."



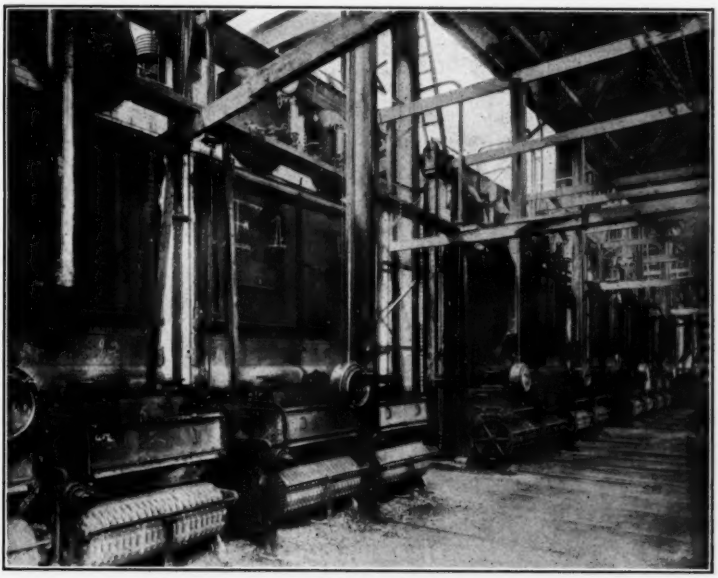
INSTALLATION OF COKER STOKERS, BRISTOL ELECTRICITY WORKS.
Meldrum Bros., Limited, Atlantic Works, Manchester.

One feature in connection with the design of mechanical stokers for marine service must be remembered, namely, that all steam used for blowers, amounting in some cases to as much as 2 to 10 per cent. of the total, is an entire loss, and must be made up with fresh water added to the boiler feed in excess of that returned from the surface condensers. Thus, in the case of a battery of nine boilers equipped with over-feed stokers, under certain conditions of draft, I have seen it necessary to use the entire amount of steam furnished by one boiler to supply itself and the remaining eight boilers.



AN INSTALLATION OF HODGKINSON'S STOKERS AT THE NEW SALFORD ELECTRIC-LIGHT STATION.
James Hodgkinson, Salford, Manchester.

With regard to the smoke-prevention value of mechanical stokers, probably the most reliable and important results available are those obtained from the work of the Paris smoke-prevention commission. Out of one hundred and ten devices examined, the greatest amount of smoke was produced by a furnace equipped with an ordinary hand-



BABCOCK & WILCOX CHAIN-GRATE STOKERS, PINKSTON POWER STATION, GLASGOW CORPORATION TRAMWAYS.

INSTALLATION OF UNDERFEED STOKERS IN DEPARTMENT STORE OF MARSHALL FIELD & CO., CHICAGO.
The Underfeed Stoker Co. of America, Chicago, Ill.

fired grate, while the least smoke was emitted by James Proctor's coking stoker. As a result of extended investigations, Mr. W. H. Bryan states that the comparative amount of smoke emitted from ordinary boiler furnaces may be taken at 46.52 per cent., and from improved mechanically fired furnaces, as 9.45 per cent., on a color scale in which absolute black is 100.

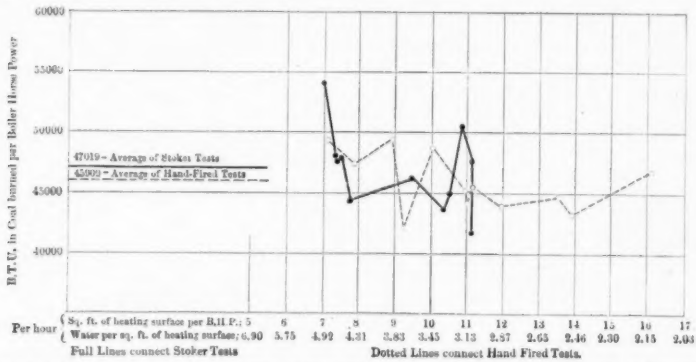
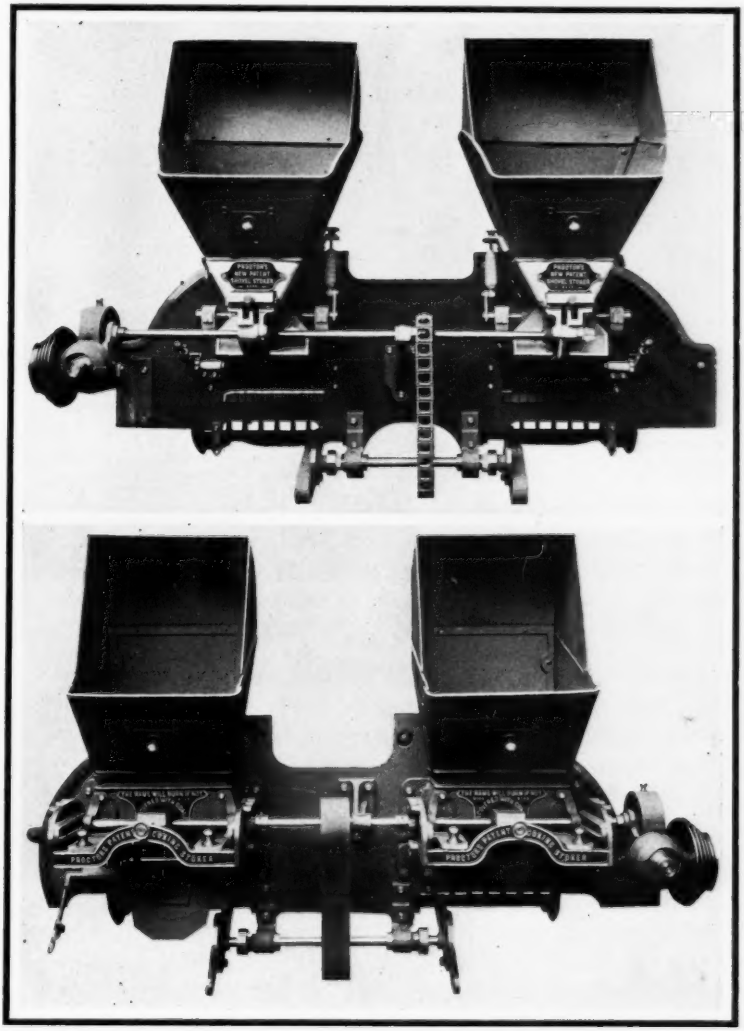

60000
55000
50000
47019 = Average of Stoker Tests
45000
45009 = Average of Hand-Fired Tests
40000
B.T.U. in Coal burned per Boiler Horse Power
Per hour
Sq. ft. of heating surface per B.H.P.: 5 6 7 8 9 10 11 12 13 14 15 16 17
Water per sq. ft. of heating surface: 6.90 5.75 4.92 4.31 3.83 3.45 3.13 2.87 2.65 2.46 2.30 2.15 2.03
Full Lines connect Stoker Tests
Dotted Lines connect Hand Fired Tests.

DIAGRAM SHOWING COMPARATIVE ECONOMY OF MECHANICAL AND HAND STOKING.

The comparative economy of mechanical and hand firing of boilers may be obtained from the above diagram, prepared from about twenty tests made by engineers of reputation, these having been selected because the heating values of the fuels had been determined by calorimeter and because all the various proportions were given.

As the mechanical stoker is a part of the boiler furnace, its value should be measured by the proportion of the heat units fed into it in the shape of coal to the heat units taken up by the water in the boiler, or the steam made, reduced to equivalent evaporation from and at 212 degrees F. With that end in view, the ordinates are B. T. U. per pound of coal multiplied by the coal fed to the stokers per boiler horse power developed. The upper row of abscissal figures are water-heating surface per boiler horse power developed. The lower row of abscissal figures are pounds of water per square foot of water-heating surface per hour. Near the left of the plotting will be noticed three points almost in the same place; they are each a different stoker, under-feed, over-feed, and coking types. The dotted line connects the ordinary hand-fired boiler tests; the full line connects the mechanical-stoker tests.

Though the average British thermal units per boiler horse power developed, fed in the shape of coal, is 47,019 for the mechanical stoker tests and 45,009 for the hand-fired tests, I will not say that hand fir-



THE UPPER PICTURE SHOWS PROCTOR'S SHOVEL STOKER; THE LOWER, PROCTOR'S COKING STOKER, DESIGNED FOR SMOKELESS FIRING.

AMERICAN STOKERS, UNDERFEED SYSTEM, AT THE HOMESTEAD MILLS, CARNEGIE STEEL CO., UNITED STATES STEEL CORPORATION, PITTSBURG, PA.
American Stoker Co., N. Y.

ing is the most economical. The diagram brings out some interesting things, and while on the face of it hand firing appears to be the most economical, yet when we consider the labor and repair side of the question, and the investment, interest, taxes, etc., in all probability in plants of over 2,000 boiler horse power in continuous operation, the mechanical stoker, properly selected for the fuel and work to be done, will prove the most economical.

Apart from considerations of economy and of smoke prevention, the introduction of the mechanical stoker is to be advocated for the reason that it supersedes one of the most fatiguing and difficult kinds of work which has been undertaken by human effort. Even in land installations the work of firing boilers is hard and dirty, while on shipboard it has long been considered the heaviest and most exhausting work which can be performed. Of all labor-saving machinery, that which relieves human beings from the stoking of boilers should be welcomed, even if no commercial advantages should result.

MONEY-MAKING MANAGEMENT FOR WORKSHOP AND FACTORY.

By Charles U. Carpenter.

VII.—THE PIECE-WORK SYSTEM AND THE FIXING OF PRICES.

Mr. Carpenter's articles began in THE ENGINEERING MAGAZINE for February, 1902, the first and second papers dealing with factory organization in its general principles and concrete examples, the third with departmentalization and systematization of the works, the fourth and fifth with the stock department and its systems, and the sixth with machining processes and tool equipment. His next paper will deal with the finding and recording of costs.—THE EDITORS.

THE system of pay is without doubt the most important branch of shop systems and management. This fact can be fully realized only by giving the closest consideration to both its direct and indirect influences. In the minds of most manufacturers it is associated only with cheapness of production and lowering of costs. This is but a very limited and narrow view of its functions and fails to include some of its most important features and most powerful influences. This influence is so all-pervading that the system of pay may aptly be termed, not only the keystone to economical production, but also the keystone to efficient factory management in its broadest and highest sense.

In introducing a system of pay the management should have many aims in view. The most important of these are as follows:—The possibility of shop economies and cheap production; the forcing of the shop to a maximum of production quickly; the attraction of expert workmen, and their encouragement to use their skill and wits to the uttermost; the singling out of the slovenly, slow workmen for either development or discharge; the cultivation of a feeling on the part of the men that the company is firm in its determination to be just and fair, and that its insistance on a high rate of production is justified by the rate of wages paid. To this feeling must be added the knowledge that the company will insist upon a full day's work.

To accomplish these aims the one important factor—"the man at the machine," with his human prejudices and his capabilities—must be carefully considered. It is, however, surprising to note how little attention is paid to this. Policies and systems vitally affecting the workman's welfare are put into force with a total disregard to both his willingness and his ability to improve himself and his product under

proper conditions, and his power to increase costs and cause other even more serious troubles in the shop when these conditions are not as they should be. Nor should these facts be lightly considered. It is difficult to overestimate the value of having your shop full of skilled, alert, and contented workmen who will give you a maximum of production. The advantage is not alone in the fact that costs of production are low. The feelings of mutual confidence and contentment, in this day of labor difficulties, are in themselves of great value to both employer and employee. The men's suggestions, given as a consequence of this feeling, and their endeavor to better themselves and their product, will not only lead to many improvements but, reacting on them, will make them stronger men and better artisans.

Almost all of the problems to be met with in instituting any system of pay will come under the following heads:

First, the right method of reaching a determination of the proper rate of production, or output, that can reasonably be expected from a workman for a fair day's pay—in other words, the time in which a job should be done.

Second, what plans can or should be adopted for forcing the shop up to this "rate of production."

Third, what will be done in case a man exceeds the estimated "rate of production" and, as a consequence, his wages exceed the accepted idea of a fair day's pay.

Workmen's Interest or Opposition.—The workmen's support or opposition is determined by the employer's action in regard to this last question. In fact, the whole structure of piece work, or a similar system of pay, hangs upon this. The solving of the first and second problems depends directly upon the action taken in regard to this one. Will the price, or rate, agreed upon be guaranteed, and will the workman be permitted to gain the benefit of his skill acquired by persistence and the use of his brains? or will the price, or rate, be cut when the prescribed limit of wages is exceeded?

Advantages of Guaranteeing Prices.—The advantages of guaranteeing the prices, or rates, are clear. Only by so doing will the expert workman be attracted, encouraged and developed. No other plan will give a satisfied and alert body of men. The determination of the proper rates of production will not be so difficult. The workmen will be willing to accept rates much lower than can be determined by either calculation or actual trial. They, knowing that personal skill enters so largely as a factor in turning out quantities of work, will often accept such rates and depend upon this skill to work up to a high rate of pay. A guarantee of this character will, in most cases, cause the rate of

production or output to rise quickly to a maximum. On the other hand, this increase to a maximum output will never occur where the policy of "cutting prices" is adhered to.

Effect of Cutting Rates. Workmen's Opposition.—In the mind of the employer there is ever present the danger of setting excessive rates, which, when guaranteed, may result in exorbitant wages to the workmen. If such is the result he considers that he has been cheated by his men in years past. Influenced both by this feeling and his natural desire to reduce costs, he cuts the prices. Now, consider the effect of this reduction upon the minds of the workers. Their first feelings are that they have been treated unjustly. They consider that the same policy of reductions will continue in the future, that they will then be deprived of the fruit of their skill and will be compelled to work at a very high rate of speed to earn a fair day's pay. Their antipathy to piece work comes as a consequence of this method of procedure. They feel that it is a plan first to gauge a man's ability, to persuade him to work as hard and fast as possible to secure a large output, and then to use this output as a basis of production and cut his wages accordingly. Even should a man feel inclined to do his day's work to the best of his ability, his fellow workmen, fearing that his output will be used as a standard and that they will be called upon to do the same amount of work and at a reduced price, will soon bring all their influence to bear to keep his output down. There is also the well-founded fear that, if they produce more work, some of the force must be dropped. Every new price is bitterly contested. The first experience with the cut fixed the workmen's determination to "get square" in the future. As a result, they purposely consume so much time on new work that it is folly to place any dependence on the time.

Determine the rates as closely as possible by calculations, and with few exceptions there will still remain the large element—"the workmen's skill"—upon which it is impossible to calculate with any degree of certainty. Of course, a close estimate can be made on work on automatic or semi-automatic machinery. It is also possible, indeed highly advisable, to determine rates on large machine work by calculation. Knowing the character of the machinery, the nature of the work, and the quality of the material, it is a comparatively simple matter to calculate the time in which the work should be done. A very different problem, however, is presented in setting proper rates for either the machining of large numbers of small parts, wherein quick handling of jigs and pieces enters so largely as a factor, or the assembling of pieces requiring manual dexterity. Here is where "personal skill" is the most important element. Its importance is equalled

only by the difficulty with which its value can be calculated. The possibility of the development of a man's skill on repetitive processes, requiring even the greatest care and exactitude, is astonishing.

Defects of the Ordinary Day-Work System of Pay.—Much of the difficulty experienced in introducing any system of pay differing from day work can be attributed to the extremely lax methods existing in many shops of handling the day-work system and the men who work under it. Certain it is that most of the difficulties arising from excessively high prices on work can be traced to this. The amount of time wasted by men working day work is astonishing. With this system of pay as ordinarily conducted, the men have to be very closely supervised and checked up in order to get even an approximation to a fair day's work. The elements of personal interest and advantage are lacking; there is neither hope of reward nor fear of punishment to spur them on. Close investigation will demonstrate that in many cases where day work has been in operation for a long time, not only is supervision lax, but also very little attention is paid to the comparison of records on jobs. Then indeed the situation is as bad as it is possible for it to be. The invariable result is that the shop is working much below its full capacity. The product costs much more than it should. The "pace of the shop" is too slow. The men show but little interest in their work; this lack of interest is often reflected in the inferior quality of the product. The element of cost is very indefinite, for, when work becomes slack, the time taken on the job, and the consequent cost of the product, increases.

The foremen and assistants, even if they are active in attempting to reduce the time on work, are often almost helpless. It is very difficult to detect the men "beating time." In fact, if the entire body of men persist in the practice, it is impossible for any foreman to accomplish much without some system of records giving a comparison of the time taken on jobs at different times. However, a vast improvement can be effected even in cases where the day-work plan is used, by reducing this to a scientific basis.

The Proper Stepping Stone to Piece Work or a Similar System. The first absolute requirement for success in securing the proper output from the works or factory is the determination of the time in which each and every job can and should be done. Some supervisors and foremen will at once declare that this is too large an undertaking; that "it is all right for your shop, but would not do for mine." I have seen this done in the largest shops turning out an immense quantity and variety of work. While it is no simple or easy matter for a shop operating under the old day-work

system, the plan when properly developed and used will be found a most effective agency for increasing the output. Granted the importance of this work, it is next necessary to consider, first, who should be intrusted with it; second, how should it be done? The work will require the greatest care, calculation and exactitude. Nothing should be left to chance or wild estimates. The method of procedure must be carefully considered and should be uniform for the entire shop. The usual plan is to put the work in the hands of the foremen. The results of adopting this policy are usually very unsatisfactory. The importance of the matter is such that it should have the attention of the best informed men in the establishment. The foremen are seldom prepared to handle the question in the most intelligent manner, as their information concerning the subject is usually neither wide nor exact. They often can not give it the attention it deserves. They are too prone to indulge in "estimates" that are far from being exact. Again, each foreman will adopt a different method of establishing rates and, consequently, there will exist as many standards and methods as there are foremen. Some will be entirely to liberal, others too close, and as a result, dissatisfaction will be rife in one department because the men in another do not experience the same difficulty in making their wages. In fact, such a method is unscientific, very uneconomical, and unsatisfactory to both employer and employee.

Establishment of a Rate-Fixing Department.—This work should be handled by a picked body of men. These men should be prepared to give the greater part of their time to a study of the best means of carrying out the general plan. I have, however, always found it advisable to consult the different foremen, as their practical information will be of great value. Their co-operation also should be secured, as, otherwise, the path to success may be found very rough. Needless to say, most of the members of this body should be expert mechanics and good judges of work. It is usually advisable to select also a few expert workmen in whom you can trust, to whom you can, if necessary, submit the work for actual trial. These men should be paid good wages, made a part of this rate-fixing department, and kept always on this work; otherwise little confidence can be put in their results.

Plans for Determining Proper Rates for Production.—The most scientific and in the end the most satisfactory manner of determining the time in which work should be done is that devised by Mr. F. W. Taylor.* Mr. Taylor advocates reducing each job down to its fundamental or elementary operations, securing the time for these elemen-

* A full description of Mr. Taylor's plan can be found in THE ENGINEERING MAGAZINE for January, 1901—the WORKS MANAGEMENT NUMBER.

tary operations, and using these data both for this and for future jobs containing many of the same elements. In this particular lies the precision of the plan. The elementary operations can be determined within a surprising degree of accuracy. When considering new work it will often be found that by making a comparison of the elementary operations, many of them will prove very similar and the others easy to calculate. The plan is invaluable for determining the time that should be taken on a new piece of work the first time it appears in the shop. Even in cases where a manufacturer will not go to this extreme, the argument for a separate department still holds good. Whether the rates are determined by calculation, observation, or actual trial, the work should be carried on as suggested. An efficient, well-posted man in charge of a few expert workmen will secure good results.

Methods of Securing Data.—The character of the data, the manner in which they should be collected, and the difficulty with which they are secured, will depend upon the nature of the work. In many cases it is a question of calculation. Knowing the character of the work to be done, the quality of the metal, the nature of the machine to be used, the quality of the cutting tool, and the possible feed and speed, the time in which the work can be done can be calculated with a surprising degree of accuracy.

The next problem to consider is the time that should be taken in handling the work through the shop. It is difficult to do this with any degree of accuracy. The workmen, knowing this, will take advantage of this fact and will consume all the time possible between the operations. When no incentive beyond their regular day-work pay exists it will always be difficult to get this time down to the point where it should be. However, it can be estimated within fairly good limits, and the workmen, knowing that reasons will have to be forthcoming for any unreasonable excess of time, will generally keep it somewhere near the allowable time. It is a large factor in the rate of production.

It is far more difficult to determine the proper rate of production where that uncertain element, "personal skill," is the largest factor. In many shops the nature of the work is such that the time required to handle a jig or fixture forms a very large percentage of the total. In very many cases only actual trial will afford a proper basis. It must be borne in mind, however, that even then this will not afford an exact estimate of the time in which the job can be done by the workman after he has developed his skill by constant work.

The proper sequence of operations for each piece of stock and the tools to be used for each operation should be carefully determined. All of these data should be tabulated and put upon a card in such

form that the workman will readily understand exactly what is wanted. He will thus have before him a complete list of operations, each machine and tool to be used, the time in which the work can and should be done, and the time allowed to handle the work. Space should be left where his actual time can be entered. Naturally, the character and extent of the data will depend upon the nature of the work.

If any manufacturer has any doubts as to the wisdom of such a plan as herein outlined, I would suggest that he give the method a thorough trial upon a few costly jobs. After these have been subjected to a thorough analysis and calculation or trial, the conclusion will be reached that this method will warrant all the time and money necessary to carry it through.

Instruction Cards.—The plan of giving "instruction cards" in connection with the bonus system outlined before the American Society of Mechanical Engineers by Mr. Gantt, is an admirable one. This instruction card contains all possible information that would be of assistance to the workman. It has upon it a description of the machine tool to be used, machine number, quality of cutting tool, order and forging numbers, class of metal, man's name and name of speed boss. Below this is a list of the operations in their sequence, the type of cutting tool to be used, full data as to size of cut, feed, time the work should take, the time it did take, and the rate. Below this, is put a sketch of the job giving the finished sizes and below this are data for drawing number, date, and signature. The note is put on the bottom: "When machine can not be run as ordered, speed boss must at once report to man who signed the slip." The instructions on these cards must be followed out to the letter. The workman should also be expected to call the foreman in case he notes that he is falling behind the time stated on the card. If the data on this card are wrong, the best time to settle the matter is at the very moment it is discovered. If the work is not progressing as it should, the foreman can then ascertain whether the fault lies in the previous calculation or in the workman. The man should be held to these rules rigorously. After these records have been secured a plan must be adopted which will compel the men to hand in the correct time on their work. Too often they indulge in guesses, or adjust the time on several jobs so as to falsify the records and mislead the foreman. This "juggling time" is very common. Naturally, it renders the records practically worthless. There are various ways in which this can be avoided. In some cases the time when jobs are begun or finished is either punched or written on the time ticket by the department foreman, assistant, or clerk. A form of clock by means of which the time of commencing and finish-

ing work is stamped on the job or time ticket is also being widely used.

Use to Make of Time Records.—Naturally, the next step is a comparison of the actual time consumed with the record time. Here the value of the instruction cards in the form outlined is apparent. The comparative data are provided upon one and the same card. This comparison, however, can easily be made even though the usual form of day-work ticket be adhered to. Permanent records of this nature, showing each man's performance on the different jobs, will be found to be of great value, especially when any system of pay other than day-work is to be introduced.

All instances in which more time is taken than is allowed must be called immediately to the attention of the foreman, who should at once demand an explanation from the workman. It is certain that these "explanations" will be forthcoming. If, however, the excess of time shows in the machining operation, it is a comparatively simple matter for the foreman to prove the accuracy of the records and the possibility of the work being done in the time set down. He is then in a position to demand that this be done in the future. As soon as this method of procedure is adopted few workmen will be found who will not at least approach the record time so far as the machine operations are concerned. It is certain that some method must be adopted which will not allow room for argument, and which will automatically check each man on every job upon which he works. This plan will accomplish this result. It is a fact, though, that however closely the men are supervised, a great difference between the records and the actual time will appear in the time taken to handle the work betwen operations. It is very difficult to reduce this variance materially on the day-work system of pay. However, a very great economy will be accomplished in the effectual reduction of the actual working time.

Character of Reports to Superintendent.—Reports should be made at least every month to the head of the factory showing just what is being accomplished in this direction. Departments in which a number of bad records are shown should be investigated. A system of rewards to the foreman and assistants whose departments show the best results will often be found advantageous. It will quicken their interest and make them much more alert. The effect will be that they will continually push their men to make better time, and the inefficient workmen who continue to make bad records will soon be either dropped or taken in hand and taught how to handle the work.

This plan of the day-work system of pay differs radically from the slipshod, inefficient, costly methods usually in vogue. It is an infinitely

more precise and scientific method. Labor costs on the day-work system of pay can not be controlled to any degree whatever unless by a plan along these or similar lines. If the average manufacturer could but realize the amounts lost by inefficient systems of time keeping, time comparison, and wage paying, he would be willing to incur any expense in order to better the conditions.

Systems of Pay Based on Rate of Production.—The great advantage of a system of pay wherein the wage to the workman is based upon his individual effort and output is, of course, apparent. The day-work system of pay, compared with such a plan, is obviously inefficient. Consequently, the manufacturer must next consider what plan of pay he should adopt for his particular factory. I do not believe that any one plan is the best for all establishments. All the conditions of a shop should be studied with extreme care before deciding.

In shops where the machinery is of a very expensive type and the actual time that should be consumed on work can be calculated to a nicety, the greatest advantage would be found in that system which will push the shop to its maximum capacity the quickest. That is undoubtedly Mr. Taylor's differential system, which guarantees prices. In other shops where this "intensity of production," as it has been termed, is not so great an advantage, and where the work is of such a character that it is impossible to determine how much work a man should turn out, the premium plan devised and developed by Mr. Halsey can be used to very great advantage. The old plan of straight piece work is still widely used, and is very successful when the prices are based upon exact data and are guaranteed.

Introduction of Piecework and Similar Systems.—It is nothing short of folly to start any system of pay unless a very complete and exact series of records exists, from which the proper rates can be calculated with safety. The assertion can also be made that unless these records are the result of some series of careful investigations and trials, they will prove to be a very weak and treacherous foundation to build upon. Unless the rates are carefully determined they will be wrong. If they are wrong the men will soon earn exorbitant wages. At this juncture the manufacturer will begin to cut his prices, and eventually the entire system will fail to accomplish its purpose.

Before any change is made from day work to piece work or a similar system, the entire list of jobs should be thoroughly investigated along lines similar to those given in this paper. The data thereby secured should be applied vigorously with a view to increasing the efficiency of the day workers. After this has been accomplished, the workmen will be perfectly willing to accept some other basis of pay.

They know that they can increase the output; they realize that this has been demonstrated, and they also know that there is a basis that is proper and just upon which to set prices and rates. They see before them a prospect of an immediate reward that it behooves them to accept. On the other hand, the employer knows that his prices will be sufficiently correct to justify him in guaranteeing them. Unless the workmen understand that he is thoroughly posted as to what the output should be, they will decrease this very materially as soon as they know that piece work is to be introduced.

Systems of Pay.—The most prominent systems of pay used at present will come under one of the following heads:—

The Day-Work Plan, with no incentive to or provision for the exceptionally skillful and fast workman.

The Premium Plan, as devised by Mr. Halsey. This has already been fully described in the January, 1901, issue of THE ENGINEERING MAGAZINE. Mr. Norris here describes how, though using this plan, he accomplishes the feature of punishing the slow worker.

Piece Work, by which the workman receives a certain amount of pay per piece, be his product small or large.

The Differential Plan, by which the price varies according to the rate of production—the greater the amount of production, the greater the price per piece.

The Bonus Plan, as described by Mr. Gannt in the paper already referred to. The workmen are provided with cards giving full data concerning tools to be used and the time in which the work should be completed. Should they reach the mark they are paid a substantial bonus for the performance; should they fail they receive pay according to their regular day rate.

The Gang Plan; work which it is very difficult to separate into distinctive operations and which requires the labor of a number of men, can be paid for by putting a price on the entire job and then paying the men in proportion to their day rates and the time each one spent on the job. This plan can be used with any system of pay.

Inspection.—The lack of a proper system of inspection very often brings these systems into disrepute. It is very necessary that some plan be adopted that will result in the work being held up to a high standard of quality and the workmen receiving pay only for that which is perfect. This was treated in a previous article.

Introduction of a Simple System of Piece Work.—While simplicity is greatly to be desired in a piece-work system, the necessity for careful counterchecks and ample protection must never be overlooked. Before starting a new system I strongly advocate a method of pro-

Form No. 724.

Dept. ..... PIECEWORK TICKET Machine No. .....

Name of piece .....

Operation .....

No. Ordered	No. Finished	LOSS	No. Accepted	PRICE	AMOUNT $	AMOUNT Cts.	Time Commenced	Time Finished
							Total Time	

Box No.

Workman .....

Foreman .....

Inspector .....

Check No.

1-3-00-10m p-F 12

cedure similar to that already laid down in this paper, namely, the increase of the efficiency of the day worker and the careful collection of reliable data giving the time in which work should be completed and, from this, the price that can be paid. These prices should be tabulated according to the work done in each department, each foreman and piece-work clerk having copies. A ticket similar to the one presented on this page, or a form affording practically the same information, should be used. All work should be assigned by the foreman. He can very easily keep a simple record showing to whom work was given, the order number, the amount of stock, and the time of starting on the job. The workman can fill out the most of this ticket when the work is completed. The columns, "Lost" and "No. Accepted" are to be filled in by the inspector, and the price by the clerk or the foreman. The foreman, after referring to his records, signs the ticket certifying that the work on this job has been done, and the ticket together with the stock-tracing card is sent to the stock tracer. The stock tracer will then turn to the proper stock-tracing and cost sheet, which can be found very easily by order number and box number. These important sheets, already described in the June issue, page 420, should be arranged together either according to order number or according to the name of the part. In most works the former

arrangement will be the better. In this way all the stock going to make up one order is grouped together, making it easy to trace and to secure costs and other information. Making the proper entries both upon this sheet and upon the stock-tracing card, he will stamp the ticket with his name indicating that this has been properly entered upon the sheet. He will then turn all of the tickets and cards over to the head inspector, who will see that the work is properly done. The inspector can locate all the stock from the data on the piece-work ticket and stock-tracing card. After he has made the proper inspection and signed his name to the ticket and card, he then turns these over to the stock tracer. If there are any losses the clerk will make the proper entries on the stock-tracing and cost sheet. The stock tracer then has all the necessary data to determine whether or not this probably unexpected loss will endanger the chances of filling the entire order on time. If so, he will secure another order for similar stock from the stock-order clerk and will rush this through so as to prevent delays. It will also be noted that an extra cost caused by a loss of this kind will be charged against the proper job and will show in the final report. The stock tracer then returns the stock card and the duplicate of the piece-work ticket to the proper foreman, who will place the card in the proper box of stock and deliver the duplicate ticket to the workman. The foreman and workman are thus notified of the condition of work as found by the inspector and, if any objections are raised, the job can be investigated before it goes farther.

The original of this piece-work ticket is sent to the piece-work clerk, or the paymaster. This depends upon the size of the concern. An inflexible rule must be made to the effect that no ticket will be considered valid without the signature of the foreman, certifying that the work was done, that of the clerk, indicating that such entries have been made that no duplication of tickets is possible, and that of the inspector, signifying that the work has been carefully examined and found correct to the extent shown on the ticket.

There may be times when it is impossible to inspect the work properly between a number of operations, and yet it is desirable to pay the man for his work. In such a case the piece-work ticket and card must be sent in by the foreman with a special notice. The piece-work ticket should be stamped "Not Inspected; Hold" and an entry made on the stock-tracing and cost sheet to the effect that the stock has not been inspected for this operation. The ticket should then be separated and sent out as originally outlined. The workman's name and all data pertaining to the work should be entered on a special sheet. A special form containing the same data should be given to the in-

spector. It will be noted that the proper entry on the stock-tracing and cost sheet will call the tracer's attention to this stock when the next entry is made. He will also have a full list showing the condition of affairs on all "not inspected" stock. This list should be followed up closely. If a further provision is made that every discharge slip should be OK'd by this stock tracer the protection will be complete. When this discharge slip comes to him, he must glance over his record to see if the man's name appears thereon. If it does, the stock must be inspected at once and any losses taken from the pay due the man. On the other hand, when the inspector does examine the stock he makes the proper entries on the special form and sends it to the stock tracer, who strikes out the entry "Not Inspected" on his sheet and sends this form to the piece-work clerk, who, according to instructions, has been holding the original of the piece-work ticket. Any deductions and "back charges" for poor work can then be made.

Practically the same method of procedure should be followed when day work is done. The ticket will naturally be practically the same.

Day Work by Piece Workers.—There should be a distinct line drawn between the work done by regular day workers, or men who never work piece work, and the day work done by piece workers. Tickets printed in different colors will prove very satisfactory.

It will thus be seen that this collection of time tickets will afford all necessary data for compiling the pay roll. It is, however, strongly advisable to adopt some system of records so that these data can be compiled in a systematic manner, affording not only a basis for the pay-roll calculations, but also for a system or series of records which will prove of the utmost value in making comparisons of the time consumed on the different jobs and in compiling reports indicating the condition of affairs in the different departments.

The record herewith given can be gotten up in card form, each man having his individual card. These cards should be grouped by departments. The columns under the heading "classifications" should be noted carefully. These columns should be headed by the various subjects used to indicate the different classes of work. The piece-work ticket will clearly indicate the class of work the man has been working on, and the time and total cost of this job will then be transferred to this card in the proper column. Taking the total of the amount there will show the total time consumed by this particular workman and his total wages. From this, the pay roll naturally will be made up. The advantage of this classification will be shown in the next article under the head of Cost. It will be noted, of course, that by adding all the totals shown on the different workmen's cards you

NAME..... CHECK NO..... DEPT. .....

Date	Name of Part	Operation	Quantity	Rate	Classification																
					Type A			Type B			Type C			Type D			Type E				
					Time	$	Cts.	Time	$	Cts.	Time	$	Cts.	Time	$	Cts.	Time	$	Cts.		

Totals .....

Total Time.....

Total Earnings.....

Total Day-work Hours.....

Total Piece-work Hours.....

Day-work in Red ink.....

Average Piece-work Earnings.....

DAY WORK AND PIECE WORK RECORD CARD.

will be able to tell immediately the number of hours worked and the amount expended in wages upon the various classes of work.

The next records are those showing the time consumed by the different workmen on the same class of work. This might properly be called job classification. It is naturally of the greatest value, as it affords all the necessary information for making comparisons of the time consumed by different men at different times. The form of this classification will be shown in the next article under Cost.

It is easy to see how simple a matter it is to classify the time tickets according to the jobs, and so collect these data. Consideration should also be given to the fact that the stock-tracing and cost sheets will show the total time consumed and the labor cost on any one article. All the sheets collected under one order number will give the total time and the total labor cost for the entire product of that order.

In a small manufacturing concern it is possible for several of these duties to be performed by one person. For instance, the paymaster can attend to the duties of the piece-work clerk, or the piece-work clerk and the stock-order clerk can be one person. This system as outlined can be worked admirably with very few men and will provide all necessary protection and a collection of invaluable data.

EDITORIAL COMMENT

THE steam-ship combination, though written upon to the point of exhaustion, one would think, still seems to command scarcely lessened attention. And with it all, it remains quite unproved that England has lost anything or America gained anything. The play was spectacular, the effect on national feeling highly emotional; a number of shareholders have received astonishingly good prices for their holdings, or have exchanged their old certificates for new ones with larger figures on them; but it is not altogether apparent how British trade is to be any worse served or American trade very much better served than it was before.

Mr. Morgan is so great a financier that any criticism—or even any lukewarmness of belief in his infallibility—seems audacious; but there is this striking difference between Mr. Morgan's earlier financiering and his later—between Morgan the re-organizer and Morgan the organizer—that his former tendency was as strongly contractionist as his latter policy is expansionist. He gained his name and power chiefly as a skilful doctor for overblown ventures which needed the knife, and his knife was ably handled, but unsparing. He cut to the bone, and never paused because blood flowed. Everything that was not sound tissue came away. He pricked the last bubble and squeezed out the last drop of water. He reduced capital and cut down dividends. Holders of six per cent securities learned that they must exchange them for three per cent securities. High-interest bond holders were given low-dividend stock, or the privilege of a fruitless contest. It was heart-rending to the reorganized, often, but it was sound, and the result was usually a sturdy, healthy, and steadily growing corporation. That was the Morgan of the nineteenth century.

* * *

But the Morgan of the twentieth century is of a different temper. His hobby appears to be the other half of financial mathematics—addition and multiplication, not subtraction and division. His joy is to swell, not to shrink, total capitalization. He delights to bring together in his laboratory vast inflated bodies which expand still further when they combine. The change is so striking that curious minds can hardly keep from asking "Why?" Has chance led Mr. Morgan latterly into contact only with undertakings whose owners had underestimated their value, as formerly it led him into association chiefly with overestimated values and possibilities? Has a new era of unmeasured prosperity set in, of which he sees the expansive power better than others do? Or has he simply grown more optimistic with the passing of years? It must be a pleasanter *rôle* than his older one for a sympathetic nature to play—much pleasanter to organize the United States Steel Corporation than to re-organize Northern Pacific, for instance. But will it stand as well? The tendency of the steel stocks, even in this time of unprecedented activity in the steel trade, suggests that it will not. And, to the non-Napoleonic mind, the shipping trust seems to belong in the same class with the steel trust.

IT is with much regret that we notice the action of the American Section of the International Association for Testing Materials, practically severing its connection with the European parent association and becoming the American Association for Testing Materials. The mere fact that individual membership in the International Association is held as a requisite for membership in the American Association counts for little in the face of the action of the American members in practically declaring their independence, an independence which really amounts to a secession, destroying in great measure the usefulness of the section.

The whole affair appears to be a perversion of the purpose of the association from scientific to commercial ends, destructive alike of its methods and its main purpose. The fundamental object of the original association was distinctly international, the intention being, not only to settle the best scientific methods of determining the true strength of materials of construction, but also to unify those methods so as to render the work of all the testing laboratories over the world directly and immediately comparable.

Up to the time of the organization of the International Association the methods of testing, the dimensions and form of test pieces, the manner of holding the specimen, of applying the load, and of recording the result, varied so widely as to render the results of many painstaking observers in different parts of the world almost useless except for the application immediately in hand. Many wearisome repetitions of work were necessary, when there were in existence records which would have been invaluable had they been intelligently applicable.

It was to do away with all this waste of time, labor, and thought, and to place all results and methods of testing on a comparable basis that the International Association was formed, and to the furtherance of this invaluable end the ablest scientists and engineers of many lands have given their best work. The formation of an American section, acting in harmony with and under the direction of the parent Association was hailed at first with satisfaction by many, it being believed that the result would be to place testing in the United States upon a higher plane, and remove from it the commercial aspect which too often clouds the scientific value of work otherwise creditable.

Unfortunately, however, the American Section has assumed that its most important function is the framing of specifications for use in commercial contracts, and, failing to divert the attention of the International Association from its primary purpose to this commercial issue, it has announced its separation, changing its name by dropping the word "International," and thus revealing the fact that it is its intention to act in independence of the rest of the scientific world. The result can readily be foreseen. The American Association can be valued no higher than it values itself, and if it elects to devote itself to specification framing instead of harmonious efforts to further the fundamental work of the International Association, its place will be fully understood and accepted.

Methods of testing are not to be devised and employed at the choice of the individuals most nearly concerned. If they are to possess permanent and scientific value they must be determined by the physical principles involved, and the main object should be the discovery of the truth about substances upon which the fate of individuals and possibly nations may depend.

REVIEW OF THE BRITISH PRESS

Twentieth-Century Locomotives.

IN a paper recently presented before the Society of Engineers, Mr. Charles Rous-Marten discussed the general question of modern locomotives in a most interesting manner, calling attention to the characteristics of the locomotives of the past century in comparison with those which are appearing as the salient features of the engines of the new century.

Mr. Rous-Marten practically confines himself to a consideration of railway practice in Great Britain and in the United States, and divides existing locomotives into two classes; those built prior to January 1, 1901, and those constructed since that date. Considering first locomotives surviving from the last century, these forming by far the greater portion of the existing engines, Mr. Rous-Marten calls attention to the great difference between British and American practice as regards the working life of a locomotive engine.

"It is always a source of wonder to visiting engineers from America or from the British colonies to find so many locomotives still at work in Britain bearing building-dates going back 30, 40 or even 50 years. In the United States an engine is deemed old at 10 years of age; ancient at 15; and utterly antediluvian at 20 years—archaic and virtually obsolete. In Britain, however, locomotives only 20 years old are looked on as quite modern, and vast numbers of them are in use. Indeed, one well-known writer on locomotive engines has deliberately adopted "the past 20 years" as the construction period which should entitle an engine to be styled a modern locomotive.

But if it be surprising to the American and the Colonial visitor to find 20-year-old engines regarded as modern and almost new fangled, it is simply paralysing to this typical guest to see locomotives still doing regular duty whose ages range up to 30, 40 and 50 years. Yet this spectacle greets him on most of the British railways. In a single case, indeed, he may behold an express locomotive bearing the date 1847—55 years ago—taking a fast train in the year 1902; for the old London and North Western 8 ft. 6 in. single-wheeler "Cornwall," which was built by Trevithick in 1847, still works, or did until very lately, expresses between Liverpool and Manchester, and once last year brought up a boat special from Liverpool to Euston, to the great edification of the American passengers. That of course is an exceptional, if not unique, case, but it is also the fact that on the same railway, the premier British line in point of importance, sixty other express engines are still running whose ages range between 40 and 43 years, the earliest having been built in 1859, while a large number more only just miss being 40 years old. Indeed, out of the total number of express engines working on the London and North Western at the present day—not quite 500—no fewer than 327, just about 65 per cent., are from 20 to 43 years old. One, as already mentioned, is 55; but that solitary case, being treated more as a curiosity than on normal lines, may be ignored. The strangeness is to find 65 per cent. of the express locomotive stock of the richest and most important British railway to be from 20 to 43 years old, leaving only 35 per cent. as aged less than 20 years. On the railways ranking next in importance, such as the Great Western, North Eastern, Midland and Great Northern, large numbers of engines are still to be found aged from 20 to 30 years, and a few whose construction dates back even to 40 years. Yet they are still running as twentieth century locomotives. This forms a curiously striking contrast to the American method."

Such a variance in operative practice must necessarily involve a great difference in constructive methods, and an examination of the locomotives shown at the Vincennes Annexe at the Paris exposition of 1900 re-

vealed a far higher degree of finish and permanence in construction for the British engines over the American. A general inspection only was needed to convince the visitor that the American engine would be old at 15 years while the British locomotive would still be young at 25. At the same time the engines shown at Paris may all be considered as twentieth-century locomotives. All were freshly out of the shops and none was put to work until the new century's first year. It was a diametrical opposition of views and aims; two directly opposite modes of promoting the same end —efficient and economic working of the railway to which each belonged. One of the most important questions in locomotive engineering which will have to be settled in this new century is—which of these two plans is the preferable one for general adoption?

So far as actual design is concerned, the differences which formerly characterized British and American practice are tending to disappear. Outside cylinders have reappeared on English engines, and cranked axles have been recently used on American locomotives. The bogie truck is no longer distinctively American, and discussion as to the relative merits of bar or plate framing excites but little interest. The main question is whether British or American methods generally shall prevail on the broader ground of commercial competition, since America has entered into Britain's own ground not only in other parts of the world but even in British colonies and dependencies.

Thie matter is not one of a decision as to the actual superiority of British or American engines per unit of actual power. It is whether American or British practice is preferable under all the circumstances of the present day. British engines are conceded to be admirable in workmanship and performance, and are so durable that they will run for 30 or 40 years without being worn out. American locomotives are efficient workers which can be delivered at very short notice, but which are not expected to last more than half as long as the British engines. Thus, in one instance, a British firm took 18 months to complete an order for locomotives given by an English colony, while an American firm required but 5 months, the American locomotives costing £400 less apiece than the British. It is obvious that when this sort of thing can be done the interests of British trade imperatively demand that the merits of the case should be clearly discerned, in order that, if the British methods be really out-of-date and unsuitable for modern needs, no time may be lost in amending them in the respects shown to call for reform.

This question naturally calls for an examination of the relative advantages of the two methods. Are long-lived engines so desirable? Is there a real gain in working engines to death in 10 to 15 years? Replying to the first, Mr. Rous-Marten says that experience shows that the older engines are not fully capable of filling existing working conditions. In many instances piloting is necessary, two engines being required to haul modern loads up gradients or to maintain speeds. Taking the practice of the Midland road, on which the old engines are given 20 per cent. less load than the newer locomotives, it is evident that a corresponding increase in general expense must be charged to them; in addition to which must be considered the reduction in the carrying capacity of the road.

For the short-lived engines there appears the fact that they are less economical in fuel consumption, although it is a question to what extent fuel consumption enters into the total cost of service. The system of early "scrapping" permits full advantage to be taken of all the latest improvements in design or construction.

There is also much less proportion of the working life of the engine spent in the repair shop, so that on the whole, much is to be said on the side of the cheaper, and shorter-lived engine.

Mr. Rous-Marten gives interesting details of the dimensions, proportions, and performances of a number of recent engines, and the excellent behaviour of the most recent locomotives in England, France and America, certainly emphasises the advantages of having roads wholly equipped with locomotives of the latest type. He makes no attempt to decide the question himself but he has certainly presented both sides in a manner which should evoke discussion as well as present material for it on both sides of the Atlantic.

Draughtsmen and Works Administration.

THERE has been recently some interesting correspondence in the columns of *Engineering* concerning the position of draughtsmen and their relation to the other departments of works administration and operation, and the subject appears to be one of sufficient importance to demand comment and discussion.

The real position of the draughtsman is one of some uncertainty, since the term includes a whole range of capacities, from the chief designing engineer down to the tracer. It is this very fact which doubtless causes some confusion in the course of the correspondence referred to, since it is apparent that in some cases the contributors are not all talking about the same thing. At the same time the fundamental principles concerned are clear enough, if the question is approached impartially and without personal bias.

In some establishments it appears that a draughtsman is supposed to have nothing to do with the work except to make drawings under specific directions from his chief. He is not permitted to go into the works, to know anything about costs of materials, labour, or finished product, and the drawings which he makes pass into the shop and disappear from his view and control. In other places the man who is entrusted with such responsible work as the making of the drawings from which the workmen get their principal instruction is held to be something more than a mere machine himself, and is given more or less insight into the conduct of the establishment and its detailed administration.

The reason generally given for the former course is that the draughtsman's work is essentially the making of drawings, and that it only takes up his time unnecessarily for him to be permitted to go into the works. He may learn too much there about departments of the business with which his particular work is not concerned, and, terrible to relate, he might possibly find out what the various products of the establishment really cost, and so learn the extent of profit made. Still more, he might, after acquiring all this forbidden knowledge, leave the service of his intelligent employers, and carry this wisdom to a rival establishment! That such disastrous contingencies may not arise, therefore, it is held most important that the draughtsman be barred altogether from the works, and that no hint of the cost of materials be allowed to reach his dangerous neighbourhood.

The other point of view, however, is beginning to receive some consideration, and it is really becoming understood that some familiarity with the immediate methods by which his plans are to be executed really forms a portion of the commercial value of a draughtsman to his employer.

There can be no possibility of question that a thorough knowledge on the part of the draughtsman of the capacity and capabilities of the tools with which the machining is to be done will materially affect the design of work, while the possession of a record of material of standard sizes and shapes in stock is essential, if he is to work intelligently.

Practical experience with the methods of pattern maker and foundryman will also guide the designer to a great extent in the drawing of plans for castings, and there is no doubt that consultations in important cases between these departments would frequently result in economy and advantage in the execution of work in the foundry and machine shop.

So far as the question of costs is concerned, experience has shown that cost clerks and estimaters must of necessity be able to read drawings intelligently and rapidly, and that while the actual work of the draughtsman in estimating may be limited to the taking out of weights and quantities, at the same time men who have had experience in the drawing room often make the best men for the cost department. Indeed it has been maintained by engineers of large experience that all the estimating and cost keeping should be in the hands of the engineering department, and that there should be no draughting room, especially so-called, but that it should be an engineering department in the fullest meaning of the term, the commercial department attending strictly to the commercial end of the business, correspondence, finances, etc.

The old-time idea of maintaining secrecy as to the shop-cost of various products is now given less consideration than formerly. Indeed when it is understood that only by careful and systematic combination of the

various elements of cost can the office administration find the true shop cost, it appears absurd to object to the draughtsman being put in possession of the cost of the detailed parts of the work. In fact it is to intelligent consideration of these elements in the design that much of the success of the establishment in reducing costs must depend. More and more is it becoming understood that the true method of cheap production lies, not in the reduction of wages and the cutting down of expense, so much as in the increase of output and the greater efficiency both of men and of every element of the plant. The cost of the product is a ratio between the total operating cost and the quantity of the product, and the best method the design that much of the success of the denominator of the fraction rather than the reduction of the numerator, and in this most important element of shop administration the draughtsman must play an intelligent part if the full value of his services is to be realised.

There is a saying in the United States that "no one ever sees an old draughtsman" meaning that the position of the draughting room is but a stage in the development of the engineer, the superintendent, the manager, in all engineering works. This being the case it is manifestly absurd to restrict the draughtsman to a contracted position and to prevent him from developing into a man of far greater usefulness to himself and to the establishment, and it is cause for satisfaction to observe that more enlightened policy is beginning to prevail.

Progress in Space Telegraphy.

THE recent address of Mr. Marconi at the Royal Institution has made public some very interesting facts in connection with the transmission of messages without wires, and from reports of his remarks we make some general abstract.

If there had been any disposition to assume that the development of wireless telegraphy would take a long time to reach a practical and commercial stage, such ideas must have been fully dispelled by the account of the rapid progress which has been made in the past six years during which Mr. Marconi has been converting the laboratory experiments of Lodge, Branly, and Hertz into a working system of long-distance communication. Thus the early transmitter, in which the use of a simple vertical wire connected to a spark coil emitted waves of electric induction, and enabled messages to be received by coherers within a radius of about 100 miles, was replaced, about a year ago, by the syntonic system. In the earlier device each receiver was acted upon by every transmitter within range and secrecy became impossible and interference frequent. The syntonic system includes a receiver adjusted to waves of one particular periodicity, this involving also a transmitter which should emit waves of the same period. This arrangement, described by Mr. Marconi in his previous address before the Society of Arts, replaces the vertical wire with two concentric cylinders of sheet metal, this giving a distinct periodicity to the emitted waves, and permitting the transmission of signals between tuned stations without affecting intermediate stations not so tuned.

A modification of the concentric oscillator is one in which a condenser circuit is placed in proximity with a vertical rod, this permitting of adjustment more readily than the concentric type. This arrangement also permits one vertical wire at the receiving station to operate a number of receiver circuits which are tuned to different waves, while it is also practicable to use one vertical transmitting wire, with connections of different inductance to several differently tuned receivers.

In all these experiments, however, the speed of transmission of messages has been limited by the action of the coherer, and it has been generally supposed that this would effectually prevent the Marconi system from becoming a formidable commercial competitor with the transatlantic cables. In his Royal Institution address, however, Mr. Marconi described his improved detector, which replaces the coherer altogether, and bids fair to work an entire revolution in the transmission of long-distance messages without wires. As described in *Engineering*, this new instrument is based on the fact that on exposing to high-period electric waves a magnet, which at the same time is subject to a varying magneto-motive force, its hysteresis is diminished, and the lag between the magnetism and the force producing it tends to vanish. The sudden cor-

responding change in the magnet's strength, due to the vanishing of its hysteresis, gives rise to currents in a coil wound around it, and these currents can be detected by means of a telephone.

One form of this detector consists of a permanent magnet which is caused to rotate slowly above a bundle of magnetised wires placed below it. The magnetic inductance through these wires is constantly changing, but from hysteresis this change lags behind its proper position. These magnetised wires are wound with a coil of wire connected with the receiver circuit, and hence when the latter is excited the hysteresis of the wires is diminished and a sound is audible in a telephone connected with a coil placed upon the magnetised bundle. A modified form of the receiver consists of a band of magnetised wires passing around two pulleys, the wires passing through a receiving coil to which the telephone is connected, a powerful fixed magnet keeping the wires magnetised. Experiments with such receivers have shown them capable of taking messages over the telephone easily at a rate of 35 words per minute, and Mr. Marconi maintains that it will be possible, with a recording attachment, to receive messages at a rate of several hundred words per minute.

The experiments conducted on board the steamship Philadelphia recently, when Mr. Marconi received messages from the station at Poldhu, Cornwall, over a distance of 1,551 miles, revealed the curious fact that communication was had over a much greater distance at night than by day. The maximum distance over which daylight signals were received was only 700 miles, and this peculiarity is attributed to the influence of sunlight upon the discharge of the transmitter. Doubtless the distance over which messages can be sent by daylight can be increased by supplying greater energy to the transmitter. It is probable that if the experiments in transatlantic communication between Poldhu and Newfoundland had been made at night, even more decisive results would have been obtained.

There appears to be little doubt that within a few years there will be regular commercial systems of communication over the Atlantic entirely independent of the existing cables, and this will also be accompanied by communication without wires over long distances in many directions. The importance of such progress can hardly be overestimated. Those inventions which abridge distance have rightly been said to add the most to human civilisation, and the ability to maintain communication over otherwise impassable areas must contribute materially to the exploitation of the world.

Thus expeditions to the far north, or to the interior of continents, such as Australia or Africa, need no longer be without communication with the rest of the world, while the facility of communication across the ocean, and the consequent reduction in cost, will tend to draw nations nearer and nearer together, and thus hasten those affiliations which will be stronger than any temporary differences.

The Training of Mining-Engineers.

TECHNICAL education has been the theme of numerous discussions of late, and among these we note the paper of Professor Wertheimer presented before the Institution of Mining Engineers, which, with the discussion following, brought out an interesting comparison between the methods of the United States and Germany with those in vogue in Great Britain.

The general trend of the paper was to the effect that a change had come over the conditions of mining education as well as of operation. The old system included apprenticeship, with all that it implied in time and opportunity of acquiring practical experience; supplemented by such night-school training as could be given upon the limited range of theoretical knowledge required or available. This is no longer practicable. Comparatively few students pursue their evening studies for a sufficiently long period to enable them to acquire an amount of knowledge to render them of greater service to their employers or to the nation. At the same time apprenticeship is no longer what it was, and there is so much more to learn in every department of industry, and the masters and principal assistants are so much busier, that a full practical acquaintance with the subject is more difficult than ever.

The obvious conclusion is that the technical training should be acquired before the entry on industrial life. Such a training should be accepted in place, not of all, but

of some part of a young man's apprenticeship in a workshop, a mine, or wherever his sphere of action may lie. This is the fact in Germany and America, where employers in the engineering industries are willing to accept from trained students a much shorter apprenticeship than is asked in the case of untrained men. In the United States especially, in nearly every case, the applications for the services of the members of the graduating classes of the technical colleges by manufacturers and business men exceed the number of graduates. Experience shows that in a few years these young men, having a sound educational basis, have acquired the practical experience far more rapidly and completely than is possible in the case of untrained men, and are then competent for a much better service than the old apprenticeship-trained man could ever have hoped to become.

As matters now stand in Great Britain, in the mining industry, the law compels a man to spend five years underground before he can qualify for his certificate, no matter what the extent of his previous education. Now if preliminary study and training do not count as the equivalent of a part of this time it will always be difficult to induce men to enter courses of study. Few men are in a position to spend the three years required to get their college or university training, and then give another five years in the pit before applying for a manager's certificate. In other countries experience has shown that the men who have had the preliminary training take much less time to acquire the practical knowledge, since they have learned how to think and apply their reasoning powers in a higher degree than the uneducated man, and know how to assimilate their experience. To compel them to spend the same number of years in acquiring the practical portion of their equipment, therefore, is to maintain that the preliminary training of the previous years is worthless. There is but one result which can be expected to follow from this position, a falling behind in the rate of progress in the industry in which it exists. That this is becoming the case in Great Britain appears in the facts brought out by the discussion. Thus, many of the improved methods in mining originated in Great Britain, but have been taken up and pushed into practical use elsewhere to a far greater extent than at home. Nearly all the coal-cutting machines, for example, were invented in England, and British engineers were the pioneers in their use, but such machines are used to a far greater extent in America than in England, and the same is true of other methods and appliances.

While British methods of instruction may be open to some criticism, there is little doubt that the principal difficulty is in the matter of legislation. In other words there must be some inducement to encourage a young man to spend his time in study for practical life. If, for instance, three years of college training were accepted in place of two years underground, there is little doubt that the further three years would produce a far better man than could be obtained by five, or indeed any number of years in the pit without the college training.

The very fact that such a discussion has attracted much attention is evidence that England is waking up to the fact that the methods which have served her so well in the past cannot be relied upon to maintain her position in the face of present competition.

She has the men and the materials, as well as the prestige and the business, but she has no longer a free field without serious competition. Her best men are alive to the situation, both as regards its needs and its dangers, and it is only necessary to awaken her people, and especially her legislators, to the demands of the time to enable proper steps to be taken to enable her to meet the competition which should prove her best stimulus.

Electric Traction on Steam Roads.

We have discussed the question of the possible replacement of steam locomotives by electric traction from various standpoints, and now we have the important paper of Professor Carus-Wilson, presented before the Institution of Electrical Engineers, nominally upon the subject of electrical traction upon steam railways in Italy, but really upon the much broader subject of the economic question of the relation of electric to steam traction in general.

The Italian question is a simple one. In the first place the steam railways are oper-

ated under an arrangement with the government, by which the latter gives the companies an annual subsidy in return for a certain proportion of the receipts. Thus, for the year 1900 the Adriatica company, which with the Mediterranean railway operates 80 per cent. of the railways in Italy, received from the government a subsidy of £2,166,000, while it paid to the government a sum equal to 40 per cent. of the total receipts, amounting to £2,040,000, the balance to the credit of the company being £126,000. This arrangement comes to an end in 1905, when the government has the option either of buying out the companies or of coming to a fresh agreement with them.

In the meantime there has arisen a formidable competition in the shape of electrically operated tramways and local lines, which, providing a cheaper and more efficient service, are seriously affecting the traffic on the main lines, and as a consequence the steam railways have introduced a service of short, electrically-driven trains, running frequently at high speeds. Professor Carus-Wilson takes this situation as an occasion of discussing the economic possibilities of the proposition, also comparing the conditions in Italy with those in England.

This is by no means a simple task, since both operating and financial methods in Italy differ so materially from those obtaining in England as to render comparisons difficult. Without going into details, for which the reader is referred to the various papers by Signor Bignami in various issues of THE ENGINEERING MAGAZINE, is appears that it has been practicable, on the Lecco-Colino line and on the Milan-Varese line, to supplement steam traction to a point which has resulted in an increase of five-fold in passenger traffic, with a doubling of receipts. The speed and frequency of trains has been doubled, and the fares reduced to 40 per cent. of their original amount. It is confidently expected that this improved service will increase the amount of traffic to such an extent that in spite of the lower rates the former deficit will be converted into a paying business.

Whether this state of affairs could be reproduced in England is a matter for discussion. In any case it is clear that the full advantages of electric traction cannot be obtained without an increase in the total running expenses, and this increase can only be met by a corresponding increase in the passenger traffic, so that the change from steam to electricity should not be made unless the increase in traffic may be reasonably expected at least to cover the increased cost of running and the interest on the capital expenditure.

"Most railway managers would probably admit that the use of electricity on existing railways is worthy of consideration, and some will even go so far as to say, '"If you can show that we should reduce our expenses by adopting electricity we would do so.' It is not, however, by reducing expenses that electricity is going to help the railways, but in enabling them to offer greatly increased travelling facilities to the public at a figure impossible with steam traction, and thus to meet the growing competition of the tramways.

"In answer to the question as to why the Italian railway companies are adopting electrical traction, it is often urged that they are doing so because of the saving effected by the use of water power in place of coal. This is, however, very far from being the case, since even with water power the expenses cannot be met unless the traffic increases. The use of water power simply reduces the increase required to pay, the reduction in the case of the Italian lines being 20 per cent. The prospects of success in England with cheap coal are more favourable than they are in Italy with water power, as is shown by the fact that the increase in the traffic required to pay expenses is less in England than in Italy.

"The figures given above do not take any account of the relative possibilities of travel development in the two countries. Milan has a population of 471,000, about equal to that of Birmingham, but the towns along the line now being electrified are all quite small, Gallarate having a population of 8,000, Varese of 6,000, and Arona of 4,000, the largest being Busto Arsizio with 13,000. Taking the different lines radiating from Birmingham, by way of comparison, we find that the united populations of the two largest towns on each line within a radius of 45 miles amount to 39, 41, 63, 86, 101, 109, 121, and 185 thousand. With these figures before one, it is difficult to avoid the con-

clusion that the possible increase in travel is far greater in England than in Italy, and that if there is a field of usefulness for electrical traction on Italian steam railways, there is a still greater field of usefulness on the railways of our own country."

While these comparisons are interesting, and to the unbiased reader appear conclusive, it is probable that any change in British railway systems will be brought about only by similar causes as those which have operated in Italy, that is, by the actual competition of electric traction on rival lines. In fact the general trend of the discussion on Professor Carus-Wilson's paper was in the line of showing how impracticable it would be to introduce in England such service as had already been shown to be successful in Italy. Probably precisely similar arguments would have been advanced by the management of the Italian railways had the question been brought before them in a similar manner. When, however, they were confronted, not by an academic paper, but by rival electric lines which were rapidly absorbing the most profitable portion of their business, they accepted the condition which confronted them, instead of opposing it by a theory, and the result has been their financial salvation. Probably it will require similar conditions to produce similar results in Great Britain, but it is possible that the longer postponement of action may materially change the conditions and render it far more difficult to secure equally good results.

The state of affairs which exists to-day in underground traction in London may be repeated on a far more extensive scale, and the appearance of rival electric traction lines for local and suburban service may place certain steam railways in a position not greatly different from that of the Inner Circle.

Shoreditch Electricity Works.

THE erection of the additional electrical generating station for Shoreditch is noteworthy mainly because of the interest which attached to the plant erected there five years ago for the burning of refuse and the generation of electricity by the heat of that combustion. Like many new things, the true purport of the earlier plant was misunderstood and exaggerated, and because the refuse was successfully destroyed and the heat of destruction utilised, the conclusion was jumped at that the refuse of a district was sufficient to produce all the electricity needed for lighting the same area.

Now that greater demands for current are made it has been found necessary to erect a new station, and the old plant being capable of taking care of the refuse, it has become necessary to arrange for the use of coal as elsewhere. The old works, opened in 1897, contained three generators of 165 kw. and three of 70 kw. each, and, as is well known, the power has been supplied by the burning of refuse in suitable destructors ever since. The new plant, of which a full account is given in a recent issue of the *Electrician*, is a very complete equipment of boilers, engines, and two multipolar generators of 800 kilowatts each, the whole being in a new power house erected at Haggerston, where every facility for fuel transport and water supply is available.

The fact that the new plant is intended for coal firing only should by no means be considered as any admission of unsatisfactory working of the older refuse-burning plant. The installation of 1897 was constructed primarily for the purpose of refuse destruction, the steam and electricity being by-products, and the measure of the success of the plant should be taken first as the completeness with which the destruction is effected. The utilisation of the heat is a cause for congratulation, but so is the fact that there is not sufficient refuse produced to supply fuel for another plant. The demands for electricity will probably continue to increase, also a healthy indication of prosperity, but any attempt to draw adverse conclusions as to the value of refuse as fuel must be checked by a careful examination of the true conditions of the situation.

Doubtless the installation of the new plant at Shoreditch will furnish occasion for those who discourage the disposal of refuse by incineration to comment upon the fact that the works there have not been extended according to the original plans, but the considerations given above should dispose of any such argument against the sanitary and economic value of properly designed destructor plants.

REVIEW OF THE CONTINENTAL PRESS

Ironmaking and Shipbuilding in Germany.

It has well been said that the finished product of one manufacturer becomes the raw material of another, and indeed it is difficult to name any material which is altogether raw from the moment man has placed his hands upon it to apply it to industrial purposes. At the same time the principal consumers of a material differ greatly in various countries. Thus in Great Britain, ever since the introduction of iron ships, the shipbuilding industries have formed the principal customers of the iron and steel makers, and indeed the great development of the steel making industries of Great Britain has been largely dependent upon the demands of the shipbuilding interests.

In other countries the case has been different, and in Germany and in the United States, for example, the manufacture of structural steel and iron has to a great extent been developed in response to the requirements of the building trade and for civil engineering work, such as bridges and similar structures. The demand for plates has been for boiler construction, and the material required for shipbuilding has formed but a small proportion of the whole.

The changed relation of the iron and steel trades to the shipbuilding industries of Germany formed the subject of a remarkable paper presented before the Düsseldorf meeting of the Schiffbautechnische Gesselschaft, by Herr E. Schroedter and the importance of the subject is such as to warrant an extended review.

Although the iron industries of Germany had existed from an early period the development of shipbuilding with iron and steel dates only from the establishment of the German Empire in 1870. Naturally the first attempts were closely modelled after British practice, and the materials came from British sources. This latter fact was due to two reasons. In the first place the German iron works were not prepared to furnish the desired sections and shapes, and, in the second place the requirements of the British Lloyds, to whose rules most of the vessels had to be built, demanded sections whose dimensions were expressed in English inches and parts. When to these was added the greater convenience of the British commercial methods, in which middlemen, dealing with numerous manufacturers, undertook the delivery of the whole quantity of rolled steel, it will be seen that the introduction of German made material was necessarily slow.

The difficulty of the specifications of the British Lloyds was overcome by the opportunities offered by the Germanischer Lloyd and by the Bureau Veritas, while the association of a number of the more important German iron works in the adoption of standard sections adapted for use in shipbuilding, after many difficulties, has resulted in the production of material, which since 1898, has entered to a great extent into the consruction of German built ships.

In order to grasp the extent of the development of German iron and steel products, Herr Schroedter gives an array of figures showing, not only the increase in output since 1880, but also the growth in dimensions of plates rolled by various leading makers. Broadly it may be stated that the producing capacity of the German works to-day is nine times what it was in 1880, having increased from 105,000 tons in 1880 to 818,000 tons in 1901, the further increase in capacity having followed during the present year.

With the development of German steel manufacture there has come also into practice the question of the differing requirements of the various organizations under whose rules vessels are built. In addition to the English Lloyd there is also the Germanischer Lloyd, the Bureau Veritas, and the Registro Italiano, for shipbuilding and the specifications of the Verein deutscher Eisenhuttenleute, for the iron and steel makers. Partly owing to the predominance

of basic steel in Germany, and for other reasons, these requirements by no means agree with each other, and it is in many cases impossible for manufacturers to produce material which will satisfy all requirements. Thus, for instance, it is possible to make furnace plates which will satisfy the rules of the English Lloyd, and will also meet the requirements of the Bureau Veritas, or the Germanischer Lloyd. It is not possible, however, that this material should at the same time fulfill the requirements of the Verein deutscher Eisenhuttenleute, or of the German or Italian Marine. For boiler shell plates the conditions are similar; plates for the English Lloyd can be made use of for the Germanischer Lloyd and for the Bureau Veritas, but not vice versa. The English Lloyd and the Verein deutscher Eisenhuttenleute completely exclude each other, while the English Lloyd and the Registro Italiana disagree to such an extent that any one who atempts to satisfy them both will have a margin of only 3 kilogrammes per square millimetre (4,267 pounds per square inch) to work upon.

In this connection the importance of so modifying the test requirements of various nations as to give substantial agreement may be emphasized and urged. Doubtless each nation has permitted specifications and test requirements to be produced and enacted upon the advice of local manufacturers so as to give sufficient strength and at the same time meet the facilities for local production. The time has now come, however, when the limitations of national boundaries must be overlooked, and specifications and test requirements and methods for all kinds of materials be made to conform to intelligent scientific practice over the entire world. No manufacturing organisation can be content with the local market alone, and yet international markets may readily be closed by the enactment of impracticable specifications. Fortunately there is in existence an important International Association for Testing Materials, including in its membership distinguished engineers from all important manufacturing countries, and devoting itself to the work of unifying and providing standard methods of testing which shall be scientifically correct and reliable, regardless of the source of the material or the methods of its manufacture. It is greatly to be hoped that the work of this important association will be permitted to influence the framing of specifications to such an extent as to avoid conflicting interests, and permit material made in any part of the world to be subjected to tests which will insure its acceptance anywhere.

There has recently appeared in the United States an unfortunate tendency to act in independence of the International Association which is greatly to be deplored, and it is hoped that wiser cousels will prevail in this important matter.

Herr Schroedter's paper is filled with interesting matter relating to the general growth of the iron and steel industries in Germany, as well as the development of German shipbuilding, and apart from its engineering interest it forms valuable reading in connection with an important department of industrial economics.

The Punching of Metals.

We have at various times referred to the excellent work by M. Codron upon the power required to perform different machine operations as the records of his work have appeared from time to time in the pages of the *Bulletin de la Société pour l'Industrie Nationale*. In a recent issue of the *Bulletin* we have some interesting accounts of experiments upon punching various metals, including the action of different kinds of punches and the power required to perform the work.

Punching is a modification of shearing, in that the fibres of the material are divided nearly at right angles to the movement of the tool, but the action is modified by the confinement of the severed material in the hole produced by the operation. Shearing takes place up to a certain depth, after which the remainder of the metal breaks away, and the plug is forced out of the hole with a rapid decrease in the resistance to the tool. These successive actions are shown by the strain diagrams, obtained by experimenting with a hydraulic punch, the pressures being ordinates and the penetrations abscissas of the recorded curve. With these direct actions are shown other complicated stresses and strains, including bending, compression, and a flow of metal, often accompanied with the formation of cracks, according to the nature of the material in

which the hole is punched. Some of these phenomena are clearly shown in the appearance of the plug which is forced out of the punched hole, this being compressed to much less than the thickness of the original depth, while in the case of iron or steel the ductility of the metal along the line of punched holes is diminished from 10 to 20 per cent.

A record diagram of the operation of punching a hole shows a definite succession of operations very clearly. At first there is a definite and practically uniformly increasing resistance opposed to the entrance of the point of the punch into the metal. Then, when the punch enters the metal, the line becomes steeper, owing to the increased resistance, but still remains straight, showing that the resistance to the shearing is directly proportional to the depth.

The maximum resistance varies according to the nature of the material, and according to the relation of the diameter of the punch to the thickness of the sheet, but some time before he maximum is reached the penetration increases more rapidly than the resistance, until, as the maximum is attained, the resistance falls off very rapidly as the metal breaks down and the plug is forced out.

M. Codron derives from his experiments a coefficient of resistance to punching R, which bears a direct proportion to the coefficient R^1 of tensile strength. This varies according to the material, ranging from 0.60 to 1.00.

A number of diagrams, for iron, steel, cast iron, copper, lead, and aluminum, as well as various alloys are discussed, but for these the reader must be referred to the original paper. From these researches much valuable information may be obtained not only in connection with the working of the various materials, but also for proportioning the material in designing punching machinery, and distributing the stresses.

In this connection some interesting experiments were made upon the action of different kinds of punches. Punches with oblique cutting edges, often advocated as superior to the ordinary square-ended punches, were shown to possess no advanages whatever, the resistance being the same in both cases, while the character of the work was not improved by the modification. Punches with multiple cutting edges were also given thorough trial, and found to be less satisfactory than the ordinary form. The successive cutting edges became choked and clogged with metal, requiring additional effort to force them through the metal, while the dragging of the abraded metal upon the sides of the hole produced inferior results to those attained with the common square punch. This action is shown, not only by the record diagrams of the tests, but also by photographs of the tools and the character of the plugs forced out by them.

In connection with the direct effort exerted by the punch itself, M. Codron discusses the distribution of the resistance throughout the entire movement of the tool, in order to enable data to be obtained for the proportioning of fly wheels for punching machines operated by cams or eccentrics. The result is the development of some valuable information, not hitherto available, as to the angular distribution of the efforts upon the rotating portion of a punching machine, enabling the forces to be laid out upon a diagram in a form suitable for use in machine design.

Too much cannot be said in commendation of the systematic manner in which M. Codron has investigated to various details of the action of different kinds of machine tools, and his researches, not only as regards punching, but in connection with grinding, turning, shearing, and other operations connected with the working of metals, should go far to remove these questions from their hitherto empirical position to a more rational and determinate status.

Russian Railway Systems.

THE development of the Russian railway systems in Asia has been along two distinct lines of traffic. The first of these, known as the Trans-Caspian system, extends from the port of Krasnowodsk, on the Caspian sea, through Aschabad, Merv, and Samarkand to Andishan. From Merv there is a branch line to Kuschk, near the frontier of Afghanistan, and there are also branch lines from Tschernjajewo to Tashkent, and from Gortschakowo to Margljan. This whole system, known as the Central Asiatic Railway, has a total length of about 2,670 kilometres (1,660 miles).

The second system is the well-known Trans-Siberian railway, extending from Tscheliabinsk, on the Ural frontier through

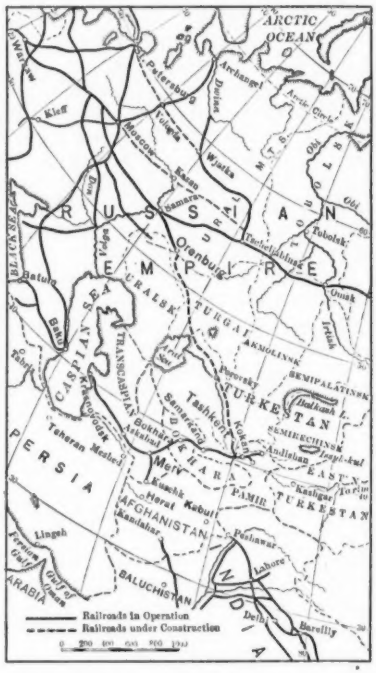
to the Pacific, with a total length of about 7,640 kilometres (4,740 miles).

At the present time the outlet of the Trans-Caspian railway system is by means of navigation between the terminus Krasnowodsk, across the Caspian to Baku, from which extends railways communication to Batoum on the Black sea and to Rostow-on-Don, and thus to the entire railway system of European Russia.

In order to connect this entire system of railways in Asiatic Russia with the European lines without requiring the water transport across the Caspian sea, a new line has been planned and is now under construction extending from Tashkent, in Turkestan, to Orenburg, on the Ural frontier and thus directly uniting the railways systems of Europe and Asia, and from a review in *Glasers Annalen* we extract a brief account of the work. The immense commercial and military importance of railway communication between Orenburg and Tashkent will be seen by reference to the map. Passing through the western portion of the province of Turgai, touching the Aral sea, and running through the middle of the province of Syr-Darja, this railway, 1,880 kilometres in length, (1,167 miles) opens up an important region.

The province of Turgai has an area of about 400,000 square versts, (about 175,000 square miles), with a population of only 460,000, mainly Kirghis, occupied in agriculture and grazing, there being also a small proportion of Bashkirs and wandering Russians. At present, apart from agricultural products, the principal production of the province is rock salt, of which extensive deposits exist in the Ilzek district. There are undoubted mineral deposits of value, including silver-lead, copper, and coal, and probably gold, awaiting development. The province of Syr-Darja has an area of 434,444 square versts, (about 190,000 square miles) with a population of about 1,500,000, and is more extensively cultivated than Turgai. Certain industries are also well developed, including the production of wine, silk, and tobacco, especially in the vicinity of Tashkent.

The greatest industrial importance of the railway to Russia, however, is the opening up of the cotton-growing district of Russian Turkestan. Formerly the cotton was



RUSSO-ASIATIC RAILWAY CONNECTIONS.

packed by hand, and transported on camels by caravan to its destination. At present compressing machinery has been introduced and the railway will permit the cotton to be sent direct by rail to Moscow and Lodz.

While the opening up of these extensive regions to commercial communication with European Russia is of vast importance, the value of the railway from a military point of view is great. A glance at the map shows more forcibly than words the relation which the development of railways bears to the policy of nations in the preparation for future control. The Trans-Caspian railway, reaching eastward from Krasnowodsk, spreads out its arms to Kuschk, right on the frontier of Afghanistan, and to the edge of the plateau of Pamir, "the roof of the world." At the same time the lines extending up from India to Peshawar, and also up to Kandahar, show how Afghanistan is enclosed between Russia and England as in a vise. The connection of the Central Asiatic Railway sys-

tem with the main lines of European Russia greatly strengthens the military importance of the network, since Russia will be able to transport men and supplies direct to Tashkent and Kuschk, without the necessity for any water transport across the Caspian.

The Vibration of Propeller Shafts.

IN view of the number of mysterious breakages of propeller shafts, under conditions in which it is evident that some other action than of the normal working stresses controlled, any systematic study of the possible causes of such disasters is to be welcomed.

In a recent issue of the *Zeitschrift des Vereines deutscher Ingenieure* is given an account of the experimental researches made by Herr Frahm, for the purpose of examining the extent to which vibrations of propeller shafts actually occur, and to deduce the influence which such vibrations may have upon the reduction in strength of the shafts. The actual torsional stresses exerted upon the shaft by the engine in transmitting the power to the propeller can be accurately determined, and there is no difficulty in so proportioning the diameter of the shaft as to meet these with a large margin of safety. At the same time it must be remembered that a shaft of the length required to extend between the thrust bearing of a marine engine and the hub of the propeller cannot be regarded as a rigid connection, but must rather be regarded as a torsional spring of more or less elasticity, operating under varying stresses.

If the propelling power originated in some uniformly acting machine, such as an electric motor or a steam turbine, the variation in the turning moments would be much less than with a reciprocating engine, in which the impulses of the steam upon the pistons act at successive intervals with a varying effect. These impulses must be transmitted to the propeller through the shaft, as an elastic connection, the result being the production of varying stresses almost impossible of numerical computation. If the action of the engine alone were to be considered, it might be possible to analyse the impulses and obtain data from which computations might be made.

The varying resistances of the propeller, however, are practically impossible of determination, including as they do the action of the waves and currents, as well as the propelling reactions against the water. It therefore becomes necessary to resort to experimental investigations, and the methods and apparatus devised for this purpose by Herr Frahm are both interesting and instructive.

The principle involved in the investigations consisted in the recording of the amount of torsional distortion existing between two points on widely separated portions of the shaft at uniform time intervals during a revolution. This information has been obtained by the following apparatus. Upon the rims of two of the flange couplings of the shaft were placed bands of thin sheet zinc, forming smooth metallic drums upon which record markings could be made by means of platinum contact points. By taking one flange immediately next to the thrust bearing and the other at the extreme end of the tunnel, close to the hub of the propeller, nearly the whole length of the shaft was put under observation. By means of an electric contact apparatus the two platinum points were put into simultaneous contact with the zinc drums at uniform time intervals, and a comparison of the records gave an accurate measure of the torsional vibrations existing in the length of shaft under consideration.

An examination of reproductions of such records, as given in Herr Frahm's paper, while interesting, does not give such an instructive idea of the action as is indicated by the same results when transformed into wave diagrams plotted in connection with the turning moments on the shaft. Such translated diagrams show very clearly the continual vibrations to which the shaft is subject, and it is apparent that such action must result in the production of severe internal stresses.

Herr Frahm gives the results of examinations of the shafts of several large steamers, and from data derived from tests of pieces of the material from which the shafts were made he compares the maximum stresses due to vibration with the mean stresses due to the ordinarily assumed working loads. Without going into details it is sufficient to state that the maximum stresses ranged from two to three times those due to a uniform turning moment,

showing the insufficiency of the ordinary methods of proportioning shafts for such service.

It is evident that any increase in the number of steam cylinders must have a material effect in distributing the impulses, and the harmonic period of the length of shaft under consideration must also be taken into account. All these elements point to the advisability of employing materially increased diameters for propeller shafts, and with the use of hollow shafts a greatly increased degree of stiffness can be secured with but little increase in weight.

The above considerations point strongly to the advantages of the steam turbine as a marine engine, and if greater freedom from shaft breakages can be shown to follow the employment of the turbine, owing to its uniform turning moment and absence of vibratory stresses on the shaft, its adoption as a measure of safety can reasonably be urged. At the same time it is important that propeller shafts should be made with a large margin of stiffness, in order to enable the shocks and vibrations due to the action of the waves and to racing to be met with safety.

Such experimental researches as those made by Herr Frahm merit recognition and encouragement, especially in that they act to disturb the too common practice of assuming as a basis for computation data which do not necessarily include all the conditions which actually exist.

Standards for Electrical Apparatus.

ABOUT a year ago, the *Verband Deutscher Elektrotechniker* adopted provisional standards for the testing of electrical machines and transformers, which were to remain in force for one year. On the whole, these have proved very satisfactory, and they are now recommended by the machinery committee for permanent adoption, with such changes and additions as experience has shown to be advisable.

The standardization is no longer confined to testing, which latter word has accordingly been dropped from the title of the report, as given in the *Elektrotechnische Zeitschrift*.

There are a few preliminary definitions, which, for the sake of a clearer international understanding, it may be well to reproduce.

A *Generator* or *Lynamo* is a rotating machine which changes mechanical into electrical energy. A *Motor* is a rotating machine which changes electrical into mechanical energy. A *Motorgenerator* is a double machine consisting of a motor and a generator, directly coupled. An *Umformer* is a machine in which the conversion of the current takes place in a common armature. (This definition corresponds particularly to our rotary converter, although a dynamotor with an armature having two separate windings would be included under it.) When the words *elektrische Maschine* or, simply, *Maschine* are used, one of the foregoing kinds of apparatus is to be understood, circumstances determining which one. *Anker* (armature) is that part of an electrical machine in which electromotive forces are generated by the action of a magnetic field.

Transformator (transformer) is an alternating-current apparatus without moving parts for changing electrical energy into electrical energy. The *Spannung* (potential or voltage) of triphase currents is the linked effective voltage between any two of the three principal conductors, or line wires. The *Sternspannung* (star voltage) of triphase currents is the voltage between the zero point and any one of the three principal conductors in a star-connected system. The *Uebersetzung* (ratio of transformation) of transformers is the ratio of the voltages at no load. *Frequenz* (frequency) is the number of complete periods, or cycles, per second.

All machines and transformers are rated by the power delivered. For continuous-current apparatus the capacity is to be given in kilowatts, and for alternating-current, in kilowatts together with the power factor.

Three classes of service are distinguished, intermittent, short time and continuous, and the normal capacity of apparatus is that which can be maintained for the time designated without exceeding the prescribed limits of temperature.

The rise of temperature is to be measured after one hour of uninterrupted operation in the "intermittent" class, and in the "short-time" class after the apparatus has been in uninterrupted operation for the time marked on the plate. In the "continuous" service class, the rise of temperature of

machines is to be measured after ten hours' operation, and of transformers after a constant temperature has been reached. Smaller machines, whose temperature will become constant in less than ten hours, may have the rise measured after a correspondingly shorter interval. When the temperature of the air is not higher than 35°C, the rise in temperature must not exceed the following figures:

(a) Insulated windings and collector rings with cotton insulation, 50°C; with paper insulation, 60°C; with mica and asbestos insulation, 80°C. A 10° higher rise is permissible for stationary coils.

(b) Commutators, 60°C.

(c) The iron of generators and motors in which windings are imbedded must not show a rise greater than that allowed for the respective classes of insulating material under (a).

Temperatures of certain parts are to be measured with thermometers, and of other parts by their increase in resistance. In the latter case, the temperature coefficient of the resistance of copper is to be taken as 0.004, when not specially determined.

Generators, motors and converters must be able to stand an overload of 25 per cent. for 30 minutes, and motors, converters and transformers an overload of 40 per cent. for 3 minutes without heating above the limits already designated.

The measurement of the resistance of insulation is not prescribed, but tests of its dielectric strength must be made at the place of manufacture, and, for large parts, also after erection. Tests are to last 30 minutes, and apparatus designed for voltages of 5000 and under must stand twice the working pressure; apparatus for voltages between 5,000 and 10,000 must be tested with 5,000 volts above the working pressure, and apparatus for voltages above 10,000 must stand one and a half times the working pressure.

The efficiency of an apparatus is the ratio of the power output to the power input, and can be determined, directly, by measuring the power, or, indirectly, by measuring the losses. The indirect methods are generally to be preferred. When the efficiency is designated, the method by which it is determined must also be given, and the following methods are prescribed: (1) the direct electric method; (2) the indirect electric method; (3) the direct brake method; (4) the indirect brake method; (5) the "no-load" method; (6) the auxiliary-motor method; (7) the steam-indicator method; (8) the "loss-separation" method, where machines can be run only by the use of "foreign" bearings.

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The Gold Deposits of Madagascar.

GOLD has long been known to exist in various parts of Madagascar, and until the French occupation of the island, the absence of means of transport has aided materially to sustain the native reports of the existence of valuable deposits. The paper of M. H. Pérès, recently presented before the Société des Ingénieurs Civils de France, and published in the *Mémoires* of the society, has dispelled most of the uncertainty relating to this matter, and placed the fact before the public in a definite manner.

One of the immediate results of the French occupation of the island has been the conduct of a thorough topographical survey, and this has naturally been followed by an investigation of the mineral riches of the country, partly stimulated by the tales of the natives as to the existence of rich gold deposits. The result of these investigations has been to dispel many of the illusions as to the existence of vast deposits of great value, and at the same time to put th gold mining industry of Madagascar

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upon a scientific and commercial foundation, freed from the vague and unreliable reports hitherto prevalent.

The island of Madagascar consists mainly of a gneiss formation, heavily plicated and dislocated. In many places this foundation rock is replaced by mica-schist, and permeated by eruptive dykes, and by numerous veins of non-auriferous quartz.

The gold is found in a quartz differing in appearance from the larger veins, appearing rather in thin veins stratified with the gneiss and mica schist. This auriferous rock is rather friable and easily broken up, so that it can be worked by washing, and in this method the gold has been extracted by the natives. Its low value renders this rock of small interest, except as indicating the origin of the placers formed by the action of streams upon the material through long periods of time.

Another kind of auriferous deposit is found in the so-called red earth, formed by the decomposition of the gneiss, and having the mineralogical name of laterite. This is composed mainly of a silicate of aluminum and iron, containing small crystals of quartz and also grains of magnetic oxide of iron.

The various sources of gold have formed the supply for the placers from which the bulk of the precious metal is obtained by washing. The small proportion of gold in the earth renders it desirable to conduct some preliminary concentration work, usually according to the native method, by cutting small artificial channels through the earth and permitting the water to wash the earth into settling pools. In this way much of the lighter earth is carried off, and the auriferous portion rendered rich enough for hand washing. The washing is performed in the pan, much as in the early days in California, and the natives have acquired much skill in the work, experiments showing that about 90 per cent of the gold in a pan of earth is recovered.

While the methods employed are primitive, yet they have the advantages of employing the very cheap native labor; more expensive methods not being warranted by the proportion of gold per cubic metre of earth. Thus a cubic metre of the auriferous gravel, of about 1,500 kilogrammes weight (1½ tons) contains before concentration only about 0.2 gramme of gold, but after concentration, when the lighter mica and clay have been partially washed off, the content is about 5 to 6 grammes per cubic metre, or say 4 grammes to the ton. Taking the value of a gramme of gold as 3 francs, we get an average for the value about 12 francs per ton, and as a native can wash only about 300 to 400 kilogrammes of gravel per day, the return is but 4 to 5 francs for a day's work. It is true that deposits have been found running as high as 30 francs to the ton, but these form but a small proportion of the total.

Since the annexation of the island by France the government has attempted to classify the placers according to their richness and to impose taxes for the benefit of the colony, but the low content of the gravel renders it difficult to do this. Later legislation has fixed the tax directly upon the gold extracted, which is more practicable of determination, although it does not bear a direct relation to the cost of extraction.

Naturally the use of dredges and similar machinery has been suggested since the French occupation, but it is a question whether their use would be profitable. The experience under similar conditions in Guiana has shown that the dredging costs about 2 francs per cubic metre, and as this is the unconcentrated gravel, it is apparent that the Madagascar deposits could not stand such a charge.

The general conclusions drawn by M. Pérès from his investigations of the gold deposits of Madagascar are, that, while gold will long continue to be one of the principal export productions of the island, its exploitation offers little to modern methods of development.

The natives will doubtless long continue to wash the gravel and by their primitive and exceedingly cheap methods will be able to find occupation and support in the industry. While it cannot be expected to form a foundation for great mining companies, therefore, it may yet serve to assist in the general development of the colony and aid in the opening up of the island and its other natural resources to the commerce of France and the world.

REVIEW OF THE AMERICAN PRESS

Engineering Education.

AMONG the papers presented before the recent convention of the Society for the Promotion of Engineering Education we notice especially the presidential address of Dr. Robert Fletcher, and the paper of Professor Edgar Marburg, from both of which we make some abstracts.

Dr. Fletcher takes as his subject the efficiency factor in engineering education, while Professor Marburg considers the evil of excessive differentiation in engineering courses, both recognizing that the usual four-year's course is insufficient for the student to acquire the general foundation upon which to build the superstructure which his active practical experience must rear.

We cannot altogether agree with the position taken by Dr. Fletcher, based upon the methods of military academies, and emphasising the importance of drill, rigid discipline, and an extreme of recitation and blackboard work in class. These features appear to savor too much of the school room and of the irresponsible student, who is made to learn the things which he would never have undertaken by himself for the love of them, or because of his own appreciation of their future value to him. If such methods are necessary we cannot hope for much of the future work of the products of such an educational mill.

The true student of engineering needs no prodding, no watching lest he "shirk," he has gotten far past that stage, and is rather watchful lest his professor himself do some shirking, for professors have been known to do such things. The engineering student, for the most part, has a fairly clear idea of the uses to which he intends to put his education, and he looks to his professors to give him the worth of his money and his time, well knowing that the latter is all too short to fit him adequately for the struggle which is before him.

This brings us to Professor Marburg's paper, which is in striking contrast to the school-boy characteristics of its predecessor.

The real trouble with the engineering student is that, having his own plans for his practical career before him, he is too apt to endeavor to secure the special training which he has elected, to the loss of the general foundation which he should have for any department of his profession. Passing over the first two years, which, it is generally agreed, should be devoted to the foundation studies in mathematics, languages, physical science, and mental training, the discussion hinges upon the extent to which the student should be permitted to elect the details of his work. In this connection Professor Marburg makes an observation which every practicing engineer will appreciate, namely, that but few engineering students have their immediate professional future safely predetermined, even three months before graduation. The young man may think he knows just what line of work he intends to pursue, but when he gets out into the world he finds opportunities in quite different lines, and if he does not get into practice in his chosen specialty he may find himself compelled to enter upon a career for which he is but imperfectly fitted.

If the work of the third and fourth years includes all the subjects which it should, there will be little time left for specialization. The number and extent of subjects which should form a portion of every engineer's working equipment, together with the laboratory practice necessary to give a living meaning to the fundamental theoretical principles, demand every moment of the time which is available. Specialization, under these cicumstances, entails the suppression or mutilation of other important subjects, and may constitute a grievous wrong to the student, and one of which he will soon be made aware in after life.

That specialization in engineering educa-

tion is becoming increasingly important is by no means denied. But in Professor Marburg's view, its place is not in the undergraduate courses. Its legitimate province is to be found in graduate instruction, and there no limits need to be set to its intensity. But schools not thoroughly equipped for this responsible work had better not attempt it. Graduate courses, if offered, should be truly worthy of the name. They should appeal to men in practice as something worth striving for. Their value should be absolutely beyond question. This means that they must be conducted by an adequate corps of able and experienced specialists, as, for example, in our best schools of medicine.

As a matter of fact most of the actual work of specialization must be done after the student has been graduated, and during the immediately succeeding years. All that can properly be done in the educational institution is to select the broad classification, as civil, mechanical, electrical, or mining engineering, and impart a thorough fundamental grounding in the principles of the science and their logical applications. The specialization will follow soon enough, if the foundation principles have been placed broad and deep in the mind of the student, while without a thorough grounding no really valuable degree of specialization can be followed.

In this connection the importance of the possesion of practical experience by the professor may be emphasised. No one is more acute to perceive the shortcomings of his instructors than the earnest and intelligent student of engineering, and with the opportunities which such students have of observing and absorbing current practice it is easy for them to see when their instructor has no working knowledge of his subject and when he is, as is too often the case, a graduate from the class room to the professional chair without any experience in the strenuous school of the shop, the field, or the line. These things cannot be evaded by the instructors under the keen inquisition of their eager pupils, and probably a most interesting paper might be presented to the society, if it could be had, upon the professor as his pupils see him, or as they find him after they have been out in the tussle for a year or two.

The Electric Driving of Machinery.

In the course of an interesting symposium at a recent meeting of the Engineer's Society of Western Pennsylvania, the subject of the electric driving of machinery was discussed in a very practical manner.

The extent to which electric driving is being used in rolling mills and at iron furnaces is clearly indicated in the discussion, and in the former class of work the applications are most numerous. Naturally the most extensive applications are in the operation of traveling cranes, this having been an early field for electric driving. Motors are also successfully employed for operating electric charging machines for open hearth furnaces, and also for driving roller tables. For many minor purposes electric motors are used in rolling mills where formerly small steam engines were employed and these uses are extending. Up to the present time, however, there is no rolling mill in the United States in which the heavy rolls are driven by electric motors, although motors of more than 400 h. p. have been sent to Europe from America for the direct driving of heavy rolls.

In modern blast furnace plants the principal use to which electric driving has been applied is the handling of materials, including unloading and dumping machinery for ore, coke and limestone; electric locomotives, conveyors, and especially hoists for lifting material to the top of the furnaces.

The good work which electric motors have done in this kind of work is shown by the fact that although the failure of a motor would cause the interruption of work to an extent hardly calculable there has been no serious rouble from such cause.

The most interesting portion of the symposium, however, is found in the paper presented by Mr. F. B. Duncan, upon electric driving in machine-shop practice.

At the present time the question of the direct electric driving of machine tools is in a transition state, and many of the combinations in use are such as to give credit to neither electrician or tool builder. Many tool makers look upon electric driving as a sort of fad which it is to their advantage to discourage, while in other instances the electrical portion of the work has been done without a proper understanding of the mechanical requirements of the situation.

Mr. Duncan classifies the difficulties in connection with the introduction of electric driving as follows:

1. The present design of machines for belt operation necessitates new patterns for many parts before they can be electrically driven.

2. The greater first-cost as yet of motor-driven tools.

3. That the present design of many tools is not heavy enough to stand positive motor operation.

4. The large demand as yet for belt driven machines compared with that of electrically operated ones, and the reluctance of manufacturers to be the pioneers in what is as yet commercially an untrodden path.

One of the most serious of all the problems on the electrical side of the question is that of speed variation, the requirements for machine-tool driving being between greater limits than is the case in other lines of work. The two methods most applicable are the use of single voltage, which permits a variation electrically of about 100 per cent. above the normal, and multi-voltage. With the former some mechanical means, such as gearing, must be used to extend the speed variations, but with the latter the desired speeds may be obtained by electrical methods alone.

Mr. Duncan calls attention to the fact that the modern high-duty tools steels, coming into general use, necessitate the redesigning of machine tools in order to enable them to stand the heavy stresses which increased speeds and cuts produce. If, in connection with such changes in form and proportion, the question of direct electric driving is taken into account an important advance would be secured.

The advantages of electrical driving are set forth as follows:

1. Greater output per machine, due to the positive nature of the driving; in many cases equal to fifty per cent.

2. Ability to determine by means of recording instruments centrally situated with a multi-point switch, whether tools are being kept at work in a proper manner, a graphical record of the time each machine is in operation being kept, together with its consumption of power. This will also enable the detection of tools which are in bad condition, due to abnormal friction of bearings or moving parts.

3. The flexibility of placement of machine tools to suit the passage of the work through the shop.

4. Free head room for the operation of traveling cranes, due to the absence of belts and overhead shafting.

5. Ability to shut down or start up any one machine independently of all others.

Mr. Duncan is of the opinion that the individual method of driving will obtain in smaller units until even the very smallest tools can be so obtained, and the crying need of the hour is an electro-mechanical tool establishment which will devote its entire energies to this field, and design and build a complete line of drill-presses, lathes, milling-machines. planers, boring-machines, etc., which will enable manufacturers to install a complete individual motor driven equipment.

Too often the main question which engineers ask about electric driving is the extent of economy in motive power. This, however, is a secondary matter. The main question is the general efficiency of the entire installation with reference to the amount of work turned out, and the final cost of the product should always be kept in view as the great and primary object.

When electrical driving becomes the rule and not the exception, it will be accompanied with the installation of central power generating stations, controlled by, and operated for the manufacturers of any given locality, and thus will be solved many of the problems relating to power production and distribution, smoke prevention, fuel handling, and all that is involved in the generation and use of power.

Tests of Reinforced Concrete.

ALTHOUGH the various methods of reinforcing the strength of concrete by imbedding reinforcements of metal has been in use for a number of years, the variety of so-called "systems" and the apparent crudity of some of them leads the observer to believe that rule-of-thumb has often prevailed in the proportioning of such structures. It is true that elaborate mathematical discussions have been published, some of them from the pens of eminent engineers, but there is little doubt that many

forms of reinforced construction in cement and concrete have been, and are being, erected with little or no attempt at scientific determination of the nature and magnitude of the stresses and strains.

For these reasons the experiments of Professor W. Kendrick Hatt, made in the laboratory of Purdue University, and presented before the recent convention of the American Section of the International Association for Testing Materials, are of much interest and value, giving, as they do the data and results of actual trials, with a scientific discussion thereon.

The tests covered only beams of reinforced concrete, the scarcity of recorded data giving results indicative of the behavior of reinforced concrete under flexure, being the motive which led to the investigation. These trials included not only the tests of the beams themselves, but also determinations of the strength of the constituents, including the moduli of elasticity and strength, in tension and compression, of the broken-stone concretes; the strength of the cement in tension and compression; the elastic limit and modulus of elasticity of the iron; analysis of the sand and stone; and tests of the adhesion between the iron and the concrete.

For the details of these and of all the tests the reader must be referred to the original paper. It is sufficient to state here that the concrete was made with a good quality of Portland cement and with broken limestone, 75 per cent. of which was retained on a ¼-inch sieve and all of which passed through a 1-inch sieve. The concrete was mixed with all the care which can be given in a technical laboratory, and there is no doubt that the results are fully as good as could be expected in practical work.

The beams were 8 inches square, and 80 inches between supports, and the tests were made at periods of 6 to 30 days after the mixing of the concrete. The reinforcement consisted of imbedded iron rods of 7/16 and ⅝ inch in diameter, imbedded in the concrete beams at 1-inch and 2-inches from the bottom. In order that comparative results might be obtained, experiments were made upon concrete beams in which no iron rods were imbedded, and thus the effect of the reinforcement was determined. In making the tests a single kind of loading was used, the load being applied in the middle, and the deflections read from both sides of the beams with micrometers. These tests were continued until rupture took place, careful observations being made to discover the point of origination of cracks.

Without going into details, the first thing to be noted is the marked increase in the strength of the beams, caused by the use of the reinforcement of the iron rods. Thus, one per cent. reinforcement, placed one inch from the bottom of the beam, increases the strength of a concrete beam from 2,300 to 7,200 pounds, and increases the flexibility from 0.01 to 0.14 inch center deflection. If the 1 per cent. reinforcement is placed 2 inches from the bottom of the beam the strength is decreased from 7,200 to 5,000 pounds, with a slight decrease in flexibility, hence the advantage of placing the reinforcement as far as practicable from the neutral axis is evident. A cinder concrete beam and a stone concrete beam, each reinforced with 2 per cent. of metal, 1 inch from the bottom face, have comparative strengths of 5,000 and 10,000 pounds respectively, and a comparative flexibility of 0.26 and 0.16 inch respectively. In the case of plain cinder and stone concrete beams, the comparative strength is 600 and 1,800 pounds, and the comparative flexibility is 0.023 and 0.016 inch respectively. It thus appears that reinforcing a beam with even 1 per cent. of steel gives it 10 times its former flexibility and more than 3 times its former strength.

An important fact in connection with the use of reinforced concrete is the increased extensibility which is given to the concrete in tension. Thus, while the plain concrete broke with an average extension of 1:7000, the reinforced concrete broke with an average extension of 1:1140. This fact has been determined by M. Considère, who says that plain concrete breaks in tension with an elongation of one part in 10,000, while reinforced concrete breaks with an elongation of 1 in 1,000. The effect of reinforcement probably is to distribute the maximum elongation over the entire length of the bar, whereas, in case of the plain concrete, the maximum elongation is confined to the fractured section.

The results of the tests was to show that

the yield point of the metal was attained before the crushing point of the concrete was reached. In none of the stone concrete beams was there any indication that the compressive strength of the concrete was reached at the load at which the reinforcement failed. Evidently the two strengths, tensile and compressive were not equalized in the beams under test. If steel reinforcement had been used the compressional strength of the concrete might have been realized. The union of the metal and the concrete was sufficient, since, in no case, did the reinforcement pull out from the surrounding concrete. At the same time the cement was amply strong, since the stones themselves were broken in the ruptured section of the beam.

Professor Hatt's paper is accompanied with numerous diagrams, showing the details of the tests, including the deflections under various loadings until purture took place. From the results of the tests he has deduced formulas for the proportioning of reinforced concrete beams, and the whole discussion of the trials is such as to place the results in the best available form for practical use.

Main-Line Electric Traction.

AMONG the valuable papers presented at the Great Barrington convention of the American Institute of Electrical Engineers we may note one by Mr. Bion J. Arnold upon the application of electric traction to main-line railways.

Ever since the disasters in the tunnel of the New York Central Railroad entering New York city it has been realized that something better than steam locomotives must be used in the tunnel, and with a view of determining the practicability of employing electric traction a number of experiments have been made to secure data as to the amount and distribution of power required for the service.

In order to obtain the necessary data Mr. Arnold conducted a series of tests upon different trains, using for the purpose the dynamometer test car owned by the Illinois Central Railway Company and the University of Illinois. This car, the construction of which is fully described in the paper, is provided with a draw-bar connected to the rod of a piston working in a cylinder filled with oil, the pressure upon the oil being transmitted to a recording device. The pressure at every moment is recorded upon a strip of paper moved by gearing upon the car axle, the time record also being marked upon the same strip by pens operated by clockwork.

Records were made by this apparatus upon every variety of train entering the Grand Central Station, and selected diagrams are given with the paper in order to show the comprehensive character of the information obtained.

The diagrams obtained from the total train service of the railways under consideration were combined and worked up very completely, with the result of demonstrating that the total annual input required for propulsion alone would be 15,768,000 kilowatt-hours. The total number of ton-miles per year for the same service was computed to be 250,285,710 ton-miles, and the ratio of these two quantities gives as the electrical energy required to haul a ton over one mile on this division, 63 watt-hours per ton-mile.

So far as the best available system for use upon this portion of railway is concerned, Mr. Arnold says:

"While it is the writer's opinion that the alternating current railway motor will yet prove to be the most efficient, all things considered, it has not yet, in his opinion demonstrated its ability to start under load as efficiently, or to accelerate a train as rapidly as the direct-current motor. The line under consideration is short, the trains numerous, and rapid acceleration desirable, all of which are considerations favorable to the direct-current motor.

"Furthermore, direct-current motors with their necessary auxiliaries have become fairly well standardized and it is the only class of electric railway apparatus available from the manufacturers of the United States without involving experimental work and large development expense.

"In view of these facts and the probable necessity for rapid construction, the writer refrained from advising anything of an experimental nature, and therefore recommended the direct-current system in combination with the third-rail for the main line, and overhead construction for the yards, all of which have demonstrated fully their

ability to meet the conditions imposed by railway operation so far as motive power is concerned, although there has not yet been an electric installation on any existing terminal that is as complex, or into which anywhere near the number of heavy trains enter as on this section of road."

The nature and extent of the investigations conducted by Mr. Arnold may be taken as an indication of the serious consideration which the railway company is giving to the subject of the electric equipment of the terminal section of its lines in New York City.

So far as operating expenses are concerned, a comparison is given between steam and electric traction which is interesting. Thus the operating expenses for steam locomotives is given as 23.05 cents per locomotive mile, and the fixed charges as 1.13 cents. For electric traction the operating expenses are lower, being but 15.80 cents per locomotive mile, but the fixed charges are necessarily higher, reaching 7.83 cents, or a total of 23.63 cents per locomotive mile.

There thus appears a slight advantage in favor of electric traction, but as the costs for electricity are estimated, it is possible that slight variations would appear in practice. At the same time it must be remembered that it is not the question of operating cost which has led to the consideration of the subject, but rather the elimination of the dangers of steam traction in a crowded tunnel. A single disaster may pile up damage suits almost sufficient to pay for the installation of an electric plant, apart from the indirect injury inflicted upon a railway, so that the question really is, not whether the road can afford to make the change, but rather whether it can afford not to do it.

The Driving of Alternators.

WE have already reviewed the subject of the parallel driving of alternating electric generators, considered mainly from the point of view of the electrician, and now we have the valuable paper of Mr. Henry E. Longwell, presented before the Engine Builders' Association, and dealing with the question from the position of the designer and builder of the steam engine.

Mr. Longwell very correctly says that the electrician starts out with the requirement that the alternators shall run at the same speed, thus throwing the whole burden upon the engine builder, and taking the case of the reciprocating engine, he shows that the speed cannot be absolutely uniform. It will vary during a single revolution, owing to the irregularity of the tangential effort on the crank pin, and it will vary from revolution to revolution because automatic governing is only a series of approximations above and below the mean speed. This is the actual condition we have to meet and it is time wasted to discuss ideal and impossible conditions. Admitting that these irregularities, which must exist to a greater or less degree, create certain electrical disturbances in the generators, it must be conceded that these electrical disturbances are communicated from one generator to another, and that there is a resultant reaction back on the engine. It is not enough for the engine designer to merely consider the action of his engine as an independent unit; it is equally necessary that he should have knowledge of the character of the reaction from the generator.

An examination of the conditions existing when two engines are arranged to drive two alternators in parallel shows at once that the usual arrangement of governing mechanism is unsuited to the service. If, by reason of small speed variations, which we might as well frankly admit are unavoidable, one generator advances ever so little ahead of the other, it takes more load. To restore equilibrium we ought to be able to reduce the steam supply to the engine that is leading and to increase the supply to the engine that is lagging behind. Now the natural tendency of the governor is just the opposite, i. e., to increase the steam supply to the heavily loaded engine and make it capable of taking more load, and to decrease the steam supply to the underloaded engine and make it less capable of taking its share of load. Furthermore the nearer perfect the governor is as regards the performance of its natural duty, the more promptly and vigorously it does the right things at the wrong time.

Discussing the synchronizing action of the two alternators, Mr. Longwell shows that, so far from being an aid to parallel running, it is really an impediment. That some synchronizing force is necessary he is prepared to admit, but he asserts, decidedly,

that in every practical case the effect of the synchronizing force of the alternators is to increase the irregularity of the angular speed of the engine, instead of to diminish it.

The correctness of this position is shown by plotting the forces graphically, and constructing the action of the synchronizinz force in the diagrams, when it becomes clear that this latter force acts in unison with the crank-pin force, and thus increases the inequalities, instead of neutralizing them.

Mr. Longwell's efforts are mainly in the direction of impressing upon the electrical engineers the fact that the electrical and dynamic features in the case are so interrelated that it is essential that they should work heartily together in the solution of the problem.

The whole matter is one of compromise. Let it be freely admitted that the irregularities in the action of the engine, do set up electrical disturbances. The reciprocating engine will always have an irregularity in angular speed and consequently electrical disturbances are inevitable. The engine builder can control the amount of this irregularity to a certain extent, but he is barred by constructional and commercial limits from reaching absolute perfection.

On the other hand, the electrical disturbances react on the engine augmenting the inherent irregularities in the latter, and the intensity of this reaction is within certain limits under the control of the electrical engineer.

It is therefore only when the engine builder and the electrical engineer each recognize the limits beyond which the other cannot go, and each endeavors honestly to make the task of the other as easy as possible, with due regard to the commercial excellence of the direct connected unit as a whole, that we may hope that the parallel operation of direct connected alternators will cease to be a subject for discussion.

Electrical Education.

WE have discussed elsewhere in this issue the general subject of engineering education, especially in connection with specialization and post-graduate studies, and in the same connection we cannot do better than to call attention to some passages in the brilliant presidential address of Mr. Charles Proteus Steinmetz, delivered at the recent convention of the American Institute of Electrical Engineers.

After discussing the modifications and transformations which have recently been made in scientific notions concerning observed phenomena, Mr. Steinmetz shows that there is a certain danger to further progress by reason of the disposition to replace facts by theories more or less adequately representing the facts, and indicates the good work which can be done in destructive criticism by the younger generation, which, after leaving college with all the theoretical armament required, is not yet handicapped by personal relations with the men whose names are identified with the ruling theories.

"All future progress in science and engineering depends upon the young generation, and to insure an unbroken advance it is of preeminent importance that the coming generation enters the field properly fitted out for the work.

"Here the outlook appears to me by no means entirely encouraging.

"It is not the object of the college or university to turn out full-fledged engineers who can handle any engineering problem of any magnitude. Heretofore the available time is altogether too short, and especially a very great deal of practical experience is required, which is not available to the educational institution. It is not necessary, either, and the college graduate is not expected to take immediate charge of engineering works of great magnitude. All the educational institution can do and should do is to fit the student so to take up the practical work as efficiently as possible, and that is to give him *a thorough understanding of the fundamental principles of electrical engineering and allied sciences,* and *a good knowledge of the methods* of dealing with engineering problems.

"The average college course at present does not do this.

"One of the reasons of the inefficiency of the present college course is the competition between colleges. By trying to teach more than other colleges, gradually the quantity of material taught by our colleges has increased so that it is not no longer possible to give a thorough understanding. Mem-

orizing takes the place of understanding. Memorizing, however, is an entirely useless waste of energy, since anything that is not perfectly understood, but merely memorized, will be forgotten in a short time if not continuously applied, and if continuously applied, it would be remembered anyway. If of the amount of material in electrical engineering as well as other branches which the educational institution of to-day attempts to teach, one-half or more would be dropped altogether, but the rest taught so as to be fully understood, with special reference to general principles and methods, the product of the institution would be far superior and more successful in practical life. To be dropped, then, are all formulæ, rules, etc., beyond the most simple ones, of the scope of the multiplication table, etc. When needed, formulæ can be derived from the fundamental principles or looked up in the literature, and their memorizing is a mere waste of valuable time, useless since the memory cannot retain them if the understanding cannot reproduce them from their premises. This, for instance, applies to the various formulæ of electromagnetic induction, the equations of the transformer and other apparatus, and theoretical investigations in general."

In common with many practical men of scientific training, Mr. Steinmetz has little or no use for the examination system as a method of determining the knowledge which has really been assimilated by the student. The examination system is not only objectionable in itself, but its use involves the employment of radically defective methods of teaching.

"One of the objectionable features of the instruction of most colleges is the step by step method. One subject is taken up, by application of sufficient time and energy pushed through, and then, after passing an examination, dropped to take up another subject. It is true that by steady application to one subject a great deal can be learned, and so splendid results derived in the examination papers, but all that is learned in this manner is forgotten just as rapidly. To understand a matter thoroughly, so as really to have a lasting benefit therefrom, and not only make a good showing in examination papers, requires several years familiarity therewith. Any subject, therefore, that is not kept up during the whole college course might just as well be dropped altogether and the time spent therein saved."

The much vexed question of the study of the English language and allied branches is dealt with plainly. It is important that the student should know how to express himself in good clear English, but the florid style of the newspaper writer is not wanted. In like manner logic should be taught, not by the mediaeval methods of the schoolmen, but by a scientist, and illustrated by examples in modern scientific investigation and not by the ancient and threadbare illustrations usually employed. Faraday's researches are given as an excellent example of clear logic and plain English, and none better could have been chosen.

"The combination of text book and home work offers a splendid means for incompetent instructors to make an elegant showing in the examination papers and turn out a very inferior grade of men, men who sometimes do not even know what real understanding means. Free lectures on subjects which the instructor himself thoroughly understands (which is by no means always the case now) make it possible to direct the course so that the student's understanding follows the course, and in this case home work becomes superfluous, excepting in connection with the laboratory. Reviewing the lectures and filling out the gaps to absence, etc., appears to be the only legitimate requirement on the student's time outside of the lecture room.

"The present method of examination, which consists in expecting the student to answer ten question or so within a few hours is faulty. It shows what the student has memorized, but not how far he understands it. Furthermore, the brilliant student who usually answers nine out of ten questions correctly, and would have answered the last if he had not made a slight mistake, displaced a decimal point or so, in practical life may be utterly useless, since while doing very rapid work his work is not reliable, while a slow man who can rely absolutely on the correctness of his work will be very successful in practice, while hardly passing a satisfactory examination."

THE ENGINEERING INDEX

THE ENGINEERING INDEX IS THE KEYSTONE OF APPLIED SCIENCE

The following pages form a DESCRIPTIVE index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world,—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every article.

(1) The full title,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published.

We supply the articles themselves, if desired.

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer and works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of any article referred to in the Index, together with all illustrations, can be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the journals indexed are given.

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BRIDGES.

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India.

Two Indian Bridges. Describes the single-track, meter-gauge Eastern Bengal State Railway bridge over the Teesta River at Kaunia, India, and the Ehegaon viaduct, Thull Gaut, of the Great Indian Peninsular Ry. 1700 w. Eng Rec—June 21, 1902. No. 48857.

Railroad Bridges.

Bridge Over the Mississippi River at Thebes, Ill. Illustrated detailed description of a double-track railroad bridge soon to be erected. 2000 w. Ry Age—June 20, 1902. No. 49015.

New York, Chicago and St. Louis R. R. Bridges. Albert J. Himes. Illustrated detailed description. 3800 w. Trans Assn of Civ Engrs of Cornell Univ—1902. No. 48595 F.

Reconstruction.

Reinforcing a Railroad Bridge in Service. Illustrated description of the method by which five 139-ft. single-track spans were reinforced, without interfering with traffic, by providing new and independent members to carry the excess of load due to heavy traffic. 1200 w. Eng Rec—June 14, 1902. No. 48787.

We supply copies of these articles. See page 809.

Reinforced Concrete.

Bridge and Concrete Steel Construction. Edwin Thacher. Lecture before the College of Civil Engineering. An account of bridge building from the writer's experience, giving descriptions of systems used and much information of interest. 6800 w. Trans Assn of Civ Engrs of Cornell Univ—1902. No. 48591 F.

Removal.

Moving a Railroad Bridge. Describes the moving of the Raritan River drawbridge, at New Brunswick, N. J. The bridge is double-tracked, with five fixed spans and one draw span. Ill. 500 w. R R Gaz—June 6, 1902. No. 48609.

Moving the Fort Wayne Bridge. Reports details and operations of a work of interest by which a double-track five-span structure is being built in the position of an old bridge which has been moved bodily at one operation to a position along side so as to maintain traffic until the new bridge is completed. 2200 w. Eng Rec—May 31, 1902. No. 48526.

Steel.

An Inquiry into the Bessemer Steel of Our Railway Bridges (Onderzoek van het Bessemerstaal in onze Spoorwegbruggen). J. Schroeder van der Kolk. Data and results of tests of steel used in the principal railway bridges of Holland. 20000 w. 2 plates. Tidschr vh Kljk Inst van Ing —May 26, 1902. No. 48971 E + F.

Suspension.

Method of Stiffening an Inclined Suspension Bridge. From a paper by T. H. Rawson and George H. Broome, presented to the Inst. of Civ. Engrs. Describes the design and erection of an interesting bridge, built as cheaply as possible, consistent with requisite strength. Ill. 1500 w. Ry & Engng Rev—June 7, 1902. No. 48709.

Trolley Bridge.

New Bridge for the Buffalo, Springville & Cattaraugus Ry. Describes the design for what will be the longest and highest trolley bridge in the United States. Plan, elevation and section are given. 700 w. St. Ry Rev—June 20, 1902. No. 49022 C.

Viaduct.

The New Kinzua Viaduct (Die Neue Kinzua Brücke). F. Müller von der Werra. A description of the new Kinzua viaduct, being mainly a discussion of the paper of the engineer, Mr. C. R. Grimm, in the Trans. Am. Soc. C. E. 3500 w. Zeitschr d Ver Deutscher Ing—May 24, 1902. No. 48914 D.

CANALS, RIVERS AND HARBORS.

Banks.

A Method of Bank Construction by Dumping from Movable Trestles. Joseph Wright. Brief illustrated description of a method recently used on the Illinois & Mississippi Canal. 600 w. Eng News—June 12, 1902. No. 48715.

Revetment Work on the Missouri River; Chicago & Alton Ry. W. R. DeWitt. Illustrated description of the design and construction of this work, carried out in accordance with the plan of the U. S. Government with all improvements. 2300 w. Eng News—June 5, 1902. No. 48702.

Breakwaters.

Concrete Breakwater Construction at Buffalo, New York. T. W. Symons. Illustrated detailed description of breakwater construction of the Great Lakes, especially the replacing of the wooden superstructure by concrete, and reasons why it cannot as well be so built at first. 7800 w. Eng News—May 29, 1902. No. 48603.

Brest.

The Commercial Port of Brest and its Immediate Future (Le Port Marchand de Brest et son Avenir Prochain). E. Duchesne. Showing the superiority of Brest over other French ports, and predicting its growth. 6000 w. Mem Soc Ing Civ de France—April, 1902. No. 48909 G.

Canal Hauling.

See Electrical Engineering, Power Applications.

Canal Navigation.

Some Phases of Canal Navigation. Editorial review of paper by Elnathan Sweet, published in the "Transactions" of the Am. Soc. of Civ. Engrs., under the title "Some Important Phases of Canal Navigation." 1600 w. Eng Rec—June 7, 1902. No. 48680.

Danube-Moldau.

The Danube-Moldau Canal Project (Die Donau-Moldau Canal Projecte). Rudolf Ritter v. Gunesch. A review of the plan to connect the upper waters of the Danube and Moldau and open a continuous waterway from the Black Sea to the North Sea. 4000 w. 2 plates. Zeitschr d Oesterr Ing u Arch Ver—May 16, 1902. No. 48930 B.

Dredges.

Cutting Machinery for Suction Dredgers. Ilustrates and describes cutting machinery designed for breaking up beds of clay, or of indurated sand, into lumps small enough to pass through the pipes and pump. 1500 w. Engng—May 23, 1902. No. 48461 A.

New French Dredges. From *La Nature*. Illustrated description of dredges which embrace the most recent improvements, and are moved under their own power. 1000 w. Sci Am Sup—June 7, 1902. No. 48621.

We supply copies of these articles. See page 809.

Flow.

Collection of Data Regarding Stream Flow. R. H. Tingley. On the need of more accurate data and methods that may be used to obtain the desired information. 1400 w. Munic Engng—June, 1902. No. 48432 C.

Measurement of the Flow of Water in the Sudbury and Cochituate Aqueducts. Walter W. Patch. Describes the method adopted for computing the flow, which is a combination of current-meter and flow formula. 2800 w. Eng News—June 12, 1902. No. 48716.

See Mechanical Engineering, Hydraulics.

Isthmian Canal.

Notes on the Geology of the Isthmus of Panama. Henry W. Edwards. Brief description of the region, of special interest at the present time in view of the canal project. 1200 w. Eng & Min Jour—June 21, 1902. No. 49026.

Problems and Methods of the Isthmian Canal Surveys. Boyd Ehle. Gives outlines of the various routes, describing the survey work. Map. 4500 w. Trans Assn of Civ Engrs of Cornell Univ—1902. No. 48596 F.

The Panama Route for a Ship Canal. Prof. William H. Burr. A complete review of the history of this route, and all matters relating to it. Ill. 7800 w. Pop Sci M—July, 1902. No. 49061 C.

Loire.

The Navigable Loire (La Loire Navigable). R. Philippe. A historical and technical account of the development of the navigation of the Loire, including the regulation of the stream and the commercial value of the traffic. Three articles. 9000 w. Génie Civil—May 24, 31, June 7, 1902. No. 48901 each D.

Sault Ste. Marie.

The Development of the Sault Ste. Marie Canal. William Gilbert Irwin. A brief review of the history and development. 2000 w. Sci Am—June 21, 1902. No. 49010.

Waterways.

The Influence of Waterways on Railway Transportation. S. A. Thompson. Showing the manner in which waterways act to promote the prosperity of competing railways. 3000 w. Engineering Magazine—July, 1902. No. 48988 B.

CONSTRUCTION.

Acoustics.

Acoustics of Halls of Audiences. C. H. Blackall. Discusses the effect of design giving results derived from personal experience. 3400 w. Technograph, No. 16—1901-2. No. 48446 D.

Beams.

Bending Moments on Beams Partially or Wholly Submerged. Fred. W. Honens. Gives the solutions for the maximum bending moments on beams which are inclined to the horizontal plane and which are either wholly or partly submerged. 1500 w. Technograph, No. 16—1901-2. No. 48452 D.

Building Details.

Extension of the Corn Exchange Bank Building, New York. Illustrated description of the enlargement by the addition of a steel cage extension. 2800 w. Eng Rec—June 14, 1902. No. 48791.

Setting the Heavy Granite Columns on the Hall of Records. An illustrated account of the transportation and setting of 40-ton columns. 600 w. Sci Am—June 7, 1902. No. 48615.

The Twenty-third Street Y. M. C. A. Building, New York. Illustrated description of unusual features in a ten-story building, which will contain an auditorium, gymnasium, swimming tank and running track, and so require heavy construction. 3500 w. Eng Rec—May 31, 1902. No. 48528.

Contracts.

The Engineer in Construction Contracts. John C. Wait. Indicates some defects and weaknesses in contracts, the correction of which will avert much unpleasantness and labor. 8500 w. Trans Assn of Civ Engrs of Cornell Univ—1902. No. 48598 F.

Costs.

Structural Costs. The present article is introductory and shows that designs are often made by men ignorant of practical work, of the costs of different classes of work, and the disadvantages that result. The subject is considered from the British point of view. 2500 w. Engr, Lond—May 23, 1902. Serial. 1st part. No. 48466 A.

Floors.

Fire Tests of Fireproof Floors by the New York Building Department. Gives the construction, with illustrations, of three new forms of fireproof floors which have been submitted with successful results to the standard fire and water tests. 1800 w. Eng News—May 29, 1902. No. 48606.

Test of a Floor System. Digest from the official report of a test made by the Dept. of Bldgs., Borough of Manhattan, of the Lockwoven Metal Concrete Floor Arch. Ill. 1200 w. Ins Engng—May, 1902. No. 48430 C.

Foundations.

Bridge Foundation Work on the Great Northern Railway of Canada. Extract from paper by J. M. Shanly, before the

Canadian Soc. of Civ. Engrs. Describes features of interest in the work. 1800 w. Ry & Engng Rev—May 31, 1902. No. 48505.

Sinking the Caissons for East River Bridge No. 3. Illustrates and describes the sinking of the caissons which form the foundations of the towers for this new bridge at New York. 1900 w. Sci Am—May 31, 1902. No. 48534.

The Pneumatic Foundations of the Battery Place Building, New York. Illustrated description of circular and rectangular caissons sunk by pneumatic methods for foundations of 20-story office building. 2100 w. Eng Rec—June 21, 1902. No. 48855.

Roads.

Broken Stone Roads Near Polo, Illinois. Leslie A. Waterbury. Describes the roads named and discusses some of the principles of road construction. 3400 w. Technograph, No. 16—1901-2. No. 48453 D.

Steel Trackway. R. H. Gage. Describes a trackway recently completed near the Union Stock Yards, Chicago, stating the objections shown by experience. Ill. 1200 w. Technograph, No. 16—1901-2. No. 48450 D.

Skeleton Construction.

The Permanency of Steel Skeleton Construction. J. K. Freitag. An examination of Gen. William Sooy Smith's opinions, and of the causes, if any, which contribute to rapid deterioration. 4200 w. Br Build—May, 1902. No. 48496 D.

Stresses.

A Derivation of Formulas for Stresses in the Curved Bottoms of Tanks. Arthur N. Talbot. Gives derivation of formulas for stresses in the cone, sphere and ellipsoid. 1200 w. Technograph, No. 16—1901-2. No. 48455 D.

The Stresses in a Steel Water-Tower. H. J. Burt. Collects and reduces to convenient working form the formulas required in solving these stresses. 4400 w. Technograph, No. 16—1901-2. No. 48454 D.

Tunnels.

Hook Mountain Tunnel. Wager Fisher. Illustrates and describes the difficulties overcome and the method of prosecuting the work in constructing this tunnel, which forms a part of the Jersey City Water Supply Co.'s pipe line. 3300 w. Trans Assn of Civ Engrs of Cornell Univ—1902. No. 48594 F.

Simplon Tunnel (Simplon Tunnel). An abstract of the fourteenth quarterly report, showing the progress of the work on the Simplon tunnel up to the end of March, 1902. Nearly 58 per cent. of the boring has been accomplished. 1800 w. Schweizerische Bauzeitung—May 17, 1902. No. 48953 B.

MATERIALS.

Asphalt.

The Asphalt and Bituminous Rock Deposits of the United States. Information from a very full report made by George H. Eldridge, and forming a part of the Annual Report of the U. S. Geol. Survey. 700 w. Eng News—June 5, 1902. No. 48703.

Cement.

Portland Cement. Richard K. Meade. Considers its constitution, properties and manufacture, and the regions where the different materials are found. 3000 w. Mines & Min—June, 1902. No. 48668 C.

Cement Plant.

A Visit to the Plant of the Edison Portland Cement Co., at Stewartsville, N. J. Plan of the works with description. 1800 w. Eng News—May 29, 1902. No. 48604.

Columns.

Practical Strength of Columns or Struts of Wrought Iron and Mild Steel. J. M. Moncrieff. Calls attention to the results of experiments on wrought iron and mild steel and applies to them the final formula deduced in an earlier paper, without dealing with the principles upon which it is based. 3800 w. Engng—June 6, 1902. No. 48772 A.

Paving Material.

Interesting Tests of Pavements in Baltimore. Statement concerning a test of the relative merits of the various materials used, and of the value of old cobble-stones relaid as a sub-base. 1600 w. Brick—June, 1902. No. 48697.

Reinforced Concrete.

Applications of the Hennebique System (Toepassing van Hennebique Constructies). H. F. Beijerman, H. van Oordt, and C. E. W. van Panhuys. An official report upon the Hennebique system of reinforced concrete, showing its applicability to public works. 10000 w. 7 plates. Tidschr v h Kljk Inst van Ing—May 26, 1902. No. 48970 E+F.

The Computations for Reinforced Concrete (Lois de Déformation, Principles de Calcul, et Regles d'Emploi Scientifiques du Béton Armé). M. Rabut. A summary of the laws deduced from experiments over a period of 5 years by M. Hennebique. 1500 w. Comptes Rendus—April 21, 1902. No. 48964 D.

See Also Civil Engineering, Bridges.

Sewer Pipe.

The Strength of Sewer Pipe. Letter from Prof. W. K. Hatt, in reply to an inquiry concerning the strength of sewer pipe and the proper methods of testing. Ill. 1700 w. Brick—June, 1902. No. 48698.

We supply copies of these articles. See page 809.

Steel.

See Civil Engineering, Bridges.

Wood Preservation.

Does It Pay To Creosote Wooden Poles for Electric Line Work? W. E. Moore. Read before the Nat. Elec. Lgt. Assn. Describes the treatment given the poles, giving the approximate cost, and the result. 1600 w. Elec Rev, N. Y—May 31, 1902. No. 48540.

MUNICIPAL.

Fire Apparatus.

Dublin's New Central Station and Fire Escape. Concerning the new fire station to cost $125,000, and the improved fire appliances. Ill. 700 w. Sci Am Sup—June 7, 1902. No. 48623.

Pavements.

A Modern Street. Dr. S. F. Peckham. An illustrated article discussing the construction of asphalt pavements, the materials, proper foundations, etc. 3000 w. Pop Sci M—July, 1902. No. 49059 C.

Bituminous Macadam Pavements. William H. Burns. Discusses the principles on which this pavement is built, its construction, treatment, etc. 2700 w. Jour Assn of Engng Soc's—May, 1902. No. 48895 C.

Refuse.

Refuse Destruction: Its Sanitary and Its Steam Raising Aspects. Frank Broadbent. The present article discusses mainly the dangers arising from the improper disposition of refuse. 2000 w. Elec Rev, Lond—May 30 1902. Serial. 1st part. No. 48644 A.

Sanitation.

The Sanitary Measures to be Adopted After Floods. George A. Soper. Extracted from the Am. Jour. of Med. Sci. Suggestions for safeguarding the health and prevention of epidemic diseases. 2800 w. Sci Am Sup—June 14, 1902. No. 48758.

Sewage.

Experiments at Worcester, Mass., on Treating Acid Iron Sewage in a Closed Septic Tank. Leonard P. Kinnicutt and Harrison P. Eddy. Report of careful experimental study, giving much information on the septic tank. Also editorial. 8800 w. Eng News—May 29, 1902. No. 48607.

The Mitchell System of Sewage Disposal. Describes works involving sedimentation followed by rapid filtration combined with aeration. 800 w. Eng Rec—June 14, 1902. No. 48790.

The Purification of Sewage. W. S. Shields. Read before the Illinois Soc. of Civ. Engrs. & Surv's. Information from the writer's experience concerning septic tanks as a means for the purification of sewage. 2500 w. Munic Engng—June, 1902. No. 48434 C.

Treatment of Sewage in a Large Open Septic Tank at Worcester, Mass. Information regarding the experience with this tank as given in Mr. Harrison P. Eddy's report for the year ending Nov. 30, 1901. 900 w. Eng News—May 29, 1902. No. 48605.

Sewers.

Heavy Sewer Construction in Concrete. E. J. McCaustland. Illustrated description of work carried out as a part of the preliminary construction made necessary by the location of the Chicago Clearing Yards. 5000 w. Trans Assn of Civ Engrs of Cornell Univ—1902. No. 48593 F.

Notes on New Orleans Drainage. I. W. McConnell. An illustrated account of this work which is nearing completion. 2000 w. Trans Assn of Civ Engrs of Cornell Univ—1902. No. 48597 F.

Relief Sewer Extension in Brooklyn. An illustrated description of difficult sewer reconstruction. 800 w. Eng Rec—May 31, 1902. No. 48527.

WATER SUPPLY.

California.

Relation of Rainfall to Run Off in California. J. B. Lippincott and S. G. Bennett. Diagrams, tables and data resulting from a study of these watersheds. 2000 w. Eng News—June 5, 1902. No. 48706.

Cast-Iron Pipe.

Preliminary Report of the Committee on Standard Specifications for Cast-Iron Pipe, with Discussions. Report presented Dec. 11,1901, with discussions received up to May 1, 1902. 22000 w. Jour N E Water Wks Assn—June, 1902. No. 48584 F.

Chicago.

Old and New Water-Works of Chicago. An illustrated account of the water system which has cost nearly $36,000,000; the great pumping plants, tunnels and cribs, etc. Reviews the history and development. 4000 w. Fire & Water—June 7, 1902. No. 48701.

Cleaning Wells.

Cleaning Out Water Wells. A. J. Bowie, Jr. Describes the construction of various wells, the troubles encountered and methods of cleaning. Ill. 2800 w. Jour of Elec—May, 1902. No. 48726.

Coloring Matter.

Investigations in Regard to Coloring Matter in Water and Methods of Removal. Discussion by Desmond FitzGerald, R. S. Weston and others. 3000 w. Jour N E Water Wks Assn—June, 1902. No. 48586 F.

We supply copies of these articles. See page 809.

Failures.

A Classified Review of Dam and Reservoir Failures in the United States. William R. Hill. Abstract of presidential address at the Chicago Convention of the Am. W. Wks. Assn. Calls attention to faulty construction resulting in disaster. 4000 w. Eng News—June 19, 1902. No. 49030.

Filtration.

Filtration at Lorain. O. H. Jewell. A report on the new iron process, with illustrated description of the plant. 3400 w. Fire & Water—June 7, 1902. No. 48700.

Fire Service.

The Philadelphia High-Pressure Fire Service. Describes a system of mains filled by fire-boats at three points along the river front. 600 w. Eng Rec—June 14, 1902. No. 48789.

Ground Water.

Ground Water (Grondwater). J. v. D. Breggen. An examination of the formation of subterranean water strata, and the methods of reaching them for water supply. 3000 w. De Ingenieur—May 3, 1902. No. 48969 D.

Hamburg.

The Development of the Hamburg Water Works (Das Hamburger Wasserwerk und die Entwicklung seiner Maschinenanlagen). R. Schröder. A fully illustrated description of the plant, including high and low-pressure pumping stations, filter beds, etc. Serial. Part I. 5000 w. Zeitschr d Ver Deutscher Ing—May 31, 1902. No. 48915 D.

Hanover.

The Water Supply and Sewerage of the City of Hanover (Die Wasserversorgung und Kanalisation der Stadt Hannover). A general account of the installation, from the report of chief engineer Bock. 2500 w. Gesundheits-Ingenieur—May 31, 1902. No. 48935 B.

Irrigation.

New Irrigation Works and Methods in Colorado. H. A. Crafts. Describes extensive works for the storage of flood waters and for the interchange of water between different canal owners. 2900 w. Eng Rec—June 21, 1902. No. 48854.

Recent Developments in Punjab Irrigation. Sidney Preston. Explains the details of one of the latest schemes for the irrigation and colonization of a large area of Crown land, which promises to be one of the most productive tracts in the country, though formerly a waterless waste. Also discussion. 10000 w. Jour Soc of Arts—May 30, 1902. No. 48636 A.

Reservoirs.

The Earth Work of the Wachusett Reservoir. Robert M. Pratt. Describes the work as carried out on this reservoir which will furnish water for the city of Boston. 1300 w. Munic Engng—June, 1902. No. 48433 C.

Turbidity.

Standard Methods of Determining Turbidity and Color in Water. Directions issued by the U. S. Geological Survey and compiled by Allen Hazen and G. C. Whipple. 3700 w. Eng Rec—June 14, 1902. No. 48792.

Water-Softening.

The Municipal Water-Softening Plant at Winnipeg. Describes a modified Clark system of softening at a plant furnishing 1,500,000 gallons daily. 1500 w. Eng Rec—June 14, 1902. No. 48788.

Water Works.

The Marlborough Water Works. George A. Stacy. Illustrates and describes the construction of these works in a Massachusetts town.ship. 3700 w. Jour N E Water Wks Assn—June, 1902. No. 48585 F.

MISCELLANY.

Address.

The Engineer of the Twentieth Century. Robert Moore. Presidential address before the Am. Soc. of Civ. Engrs. On the relation between engineering and education in the new century. 3300 w. R R Gaz—June 6, 1902. No. 48613.

China.

Up-to-date Chinese Engineering. L. F. Bellinger. Photographs taken by Prof. G. D. Brill, with brief descriptions. 1700 w. Eng News—June 19, 1902. No. 49027.

ELECTRICAL ENGINEERING

COMMUNICATION.

Cables.

Air-Spaced Cables: Their Treatment and Use. G. E. Fletcher. Read at Manchester meeting of the Inst. of Elec. Engrs. Gives the writer's experience in laying down and maintaining this form of insulated conductor for telegraphic and telephonic lines, which he regards with favor. Ill. 3000 w. Prac Engr—May 23, 1902. No. 48480 A.

Coherers.

The Coherer. William A. Del Mar. A brief review of the history and theory and an illustrated description of how to

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make a modern coherer. 2300 w. Sci Am Sup—June 21, 1902. No. 49011.

Competition.

The Magnitude of Telephone Competition. Fred de Land. Gives statistics of the Bell Telephone showing what a powerful competitor the Independents have to meet. 2400 w. Elec Rev, N. Y—June 21, 1902. No. 49009.

Electric Photography.

An Apparatus for Long-Distance Electric Photography (Ueber einen Apparat zur Herstellung von Elektrischen Fernphotographien). A. Korn. Giving the results of the experimental transmission of photographic images. 1800 w. Elektrotech Zeitschr—May 22, 1902. No. 48940 B.

Exchange.

Ventilation and Heating the Twin City Telephone Exchange, St. Paul, Minn. Illustrated description of an installation where considerable attention was given to the problem of removing dust from the fresh air supply. 800 w. Eng Rec—May 31, 1902. No. 48529.

Military Service.

Electricity in the Signal Corps. Lieut.-Col. Samuel Reber. An illustrated article reviewing the applications of the telephone, telegraph and cable in military service. 4400 w. Trans Am Inst of Elec Engrs—May 28, 1902. No. 48882 D.

Submarine Cable Testing in the Signal Corps, U. S. Army. Townsend Wolcott. Describes the regular tests made in modern cable testing. 4300 w. Trans Am Inst of Elec Engrs—May 20, 1902. No. 48883 D.

The Military Cable System of the Philippines. Capt. Edgar Russel. Describes somewhat fully the laying of the cables to connect the various islands. Ill. 4000 w. Trans Am Inst of Elec Engrs—May 28, 1902. No. 48885 D.

Repeater.

The Guarini Automatic Wireless Telegraph Repeater. A. Frederick Collins. Illustrates and describes the construction of this apparatus. 2500 w. Elec Wld & Engr—May 31, 1902. No. 48602.

Space Telegraphy.

Long-Distance Wireless Telegraphy and Hertzian Waves. Edward P. Thompson. An argument tending to prove that long-distance wireless telegraphy is not operated by aerial Hertzian waves. 1800 w. Elec Wld & Engr—June 14, 1902. No. 48860.

The Braun and Siemens and Halske Wireless Telegraph System. A. Frederick Collins. Illustrates and describes Dr. Braun's invention, explaining the general points. Of interest because of a recent suit in which the Braun contentions have been sustained. 3000 w. Elec Wld & Engr—June 14, 1902. No. 48858.

Wireless Telegraphy. Brief review of the history of this discovery and the method by which messages are sent great distances without the intervention of a wire. Ill. 1300 w. Can Engr—June, 1902. No. 48633.

Wireless Telegraphy—United States Navy. Lieut. A. M. Beecher. Explains how electric waves are produced and describes the apparatus employed in wireless telegraphy. 3200 w. Trans Am Inst of Elec Engrs—May 28, 1902. No. 48888 D.

Storage Batteries.

Care of Storage Batteries in Telephone Plants. S. P. Grace. Describes the batteries used, discussing their efficiency and maintenance. 8000 w. Telephony—June 1902. No. 48564.

Telegraphy.

Rapid Telegraphy. George S. Macomber. An interesting account of the inventions for this purpose by Patrick B. Delany and of the multiplex telegraphic apparatus invented by Paul La Cour, of Copenhagen, Denmark. Ill. 2800 w. Sib Jour of Engng—May, 1902. No. 48831 C.

Telephone Lines.

Placing Telephone Lines Underground. John S. Huntoon. Illustrates and describes the work as carried out at Davenport, Iowa. 1500 w. Technograph, No. 16—1901-2. No. 48448 D.

Telephony.

Telephony. W. H. Radcliffe. The first of a series of articles, commencing with the fundamental principles and presenting in full the most advanced practice in construction, the exchange and its equipment, and recent important developments. Ill. 1400 w. Elec, N. Y—June 4, 1902. Serial. 1st part. No. 48625.

The People's Telephone and Telegraph Company's Exchange. Illustrated description of a model independent plant at Knoxville, Tenn. 2400 w. Elec Rev, N. Y—June 21, 1902. No. 49008.

The Railroad Telephone. C. A. Hammond. Discusses the advantages of the telephone in railway operation. 1600 w. R R Gaz—June 13, 1902. No. 48750.

DISTRIBUTION.

Aluminum.

Electrical Conductivity of Aluminum. W. Murray Morrison, in *Aluminum World.* Information concerning the conductivity of aluminum, and showing that under certain circumstances aluminum cables are considerably cheaper than copper. 1800 w. Am Mfr—May 29, 1902. No. 48495.

Cut Out.

The Use of the Long-Distance High-Pressure Cut-Out (Der Hochspannungs

We supply copies of these articles. See page 809.

Fernschalter und Seine Verwendung). J. Schmidt. Describing an apparatus for cutting out transformers in a distribution system, when not required. Serial. Part I. 2000 w. Elektrotech Zeitschr—June 12, 1902. No. 48949 B.

Switches.

Some Points in Switch Construction. Alf. H. Mayes. Calls attention to easily remedied faults. 700 w. Elec Rev, Lond—June 13, 1902. No. 48871 A.

ELECTRO-CHEMISTRY.

Accumulators.

Influence of Temperature on the Capacity of Accumulators. W. Hibbert. Discusses figures obtained in extensive series of experiments confirming that a rise of temperature causes a marked increase in capacity. 1100 w. Elec Rev, Lond—May 30, 1902. No. 48643 A.

The Perfect Light-Weight Storage Battery. Illustrates and describes the Perret cell, stating its desirable features. 1000 w. Sci Am Sup—May 31, 1902. No. 48538.

Carbon.

The Fusion of Carbon (Die Schmelzung der Kohle). Dr. A. Ludwig. A discussion of the efforts which have been made to effect the fusion of carbon, and the conditions which should be fulfilled. 3000 w. Zeitschr f Elektrochemie—May 8, 1902. No. 48962 G.

Electro-Chemistry.

The Development of Electro-Chemistry. R. H. Johnston. Reviews the history, considering the more important applications. 8400 w. Sch of Mines Qr—June, 1902. No. 48842 D.

Electro-Galvanizing.

Some Notes on Electro-Galvanizing. Sherard Cowper-Coles. Illustrates and describes a recently erected plant for this work, and suggests the means of securing successful work. 700 w. Elec Rev, Lond—May 23, 1902. No. 48475 A.

Ions.

The Ion Theory. F. G. Wiechmann. A brief account of this theory upon which electro-chemistry is largely based. 6000 w. Sch of Mines Qr—April, 1902. No. 48841 D.

Tin Recovery.

The Electrical Recovery of Tin from Tin-Plate Wastes (Die Elektrochemische Entzinnung der Weisblechabfälle). Dr. H. Mennicke. Discussing the practicability of recovering the tin from tin-plate wastes by use of a solution of caustic soda and an electric current. Serial. Part I. 2500 w. Zeitschr f Elektrochemie—May 22, 1902. No. 48963 G.

Transforming.

The Electro-Chemical Transformation of Alternating to Continuous Currents (Beiträge zu dem Problem der Elektrochemischem Umformung von Wechselstrom in Gleichstrom durch Aluminium Elektrolytzellen). Dr. E. König. Recording experiments upon the method of Graetz, using aluminum anodes, platinum cathodes, and an electrolyte of alum solution. 2000 w. Elektrotech Zeitschr—May 29, 1902. No. 48944 B.

ELECTRO-PHYSICS.

Alternating Currents.

How Alternating Currents Vary with the Shape of the E. M. F. Wave. Alexander Russell. Mathematical investigation showing how the shape of the current wave depends on the resistance in the circuit, and how its effective value depends on the shape of the E. M. F. wave. 1400 w. Elec Rev, Lond—May 30, 1902. No. 48647 A.

Armatures.

The Theory of Equalizing Connections on Continuous Current Armatures. Abstract of an article by Prof. E. Arnold, in the *Elektrotechnische Zeitschrift*. Mathematical discussion of the connection of the equipotential points of the armature winding. Ill. 2700 w. Elec Engr, Lond—June 13, 1902. No. 48866 A.

Electrical Discharges.

Some Experiences With Powerful Electric Discharges. John Trowbridge. Report of observations made upon a spectrum of an exceedingly powerful discharge through the ordinary vacuum tube used in the study of the spectro of gases. Also editorial note. 700 w. Elec Rev, N Y—May 31, 1902. No. 48539.

Hysteresis.

Notes on Rotary Hysteresis (Beitrag zur Kenntniss des Verhaltens der Rotirenden Hysteresis). M. Schenkel. Data and results of experiments made in the electrical laboratory of the Technical High School at Dresden. 1500 w. Elektrotech Zeitschr—May 15, 1902. No. 48937 B.

Induction.

On an Inductive Circuit with a Harmonically Varying Resistance. T. Mizuno. Mathematical investigation. 400 w. Elect'n, Lond—May 30, 1902. No. 48650 A.

Iron Testing.

A New Apparatus for Testing Iron (Vorschlag zu Einem Neuen Eisenprüfapparat). R. Richter. Describing a simple apparatus for determining the permeability of sheet iron, and its suitability for use in electrical machinery. 1500 w. Elektrotech Zeitschr—June 5, 1902. No. 48946 B.

Laboratory.

I. The National Physical Laboratory. Albert Campbell. A brief description of

some of the electrical apparatus. II. Wiring for Experimental Work. W. P. Steinthal. Illustrates and describes the general scheme. 3000 w. Elec Rev, Lond—June 6, 1902. No. 48770 A.

Periodic Curves.

Lag and Lead. W. G. Rhodes. An explanation of the phase relationship between periodic curves. Mathematical. 900 w. Elec Rev, Lond—June 13, 1902. No. 48870 A.

Radiography.

On the Radio-Activity of Matter. Henri Becquerel. Facts in regard to obscure radiations which traverse opaque bodies, and other phenomena. An interesting report of experimental investigations. 4800 w. Sci Am Sup—June 7, 1902. No. 48620.

Waves.

Electric Waves and Their Effect on the Human Brain. A. Frederick Collins. An illustrated detailed account of experiments made for the purpose of establishing the nature of the relationship existing between electric storms and certain forms of nervous diseases. 2300 w. Elec Rev, Lond—May 23, 1902. No. 48474 A.

The Effect of Electric Waves on the Human Brain. D. McIntosh and J. Graham-Willmore. Experimental investigations disagreeing with the results given in an article by A. Frederick Collins, claiming that brains exhibit the "coherer effect" and drawing conclusions. 2500 w. Elec Wld & Engr—May 31, 1902. No. 48601.

GENERATING STATIONS.

Alternators.

The Determination of Alternator Characteristics. L. A. Herdt. A discussion considering, both theoretically and experimentally, the E. M. F. induction and current relations under different conditions as to load and power factor in the armatures of several types of alternating current generators, and indirect methods for obtaining the regulation of a particular machine developed and applied to those of other types. Ill. 5000 w. Trans Am Inst of Elec Engrs—June 18, 1902. No. 49053 D.

Chaudiere Falls.

Canadian Electric Light Company's Water Power Development at Chaudiere Falls. Describes this power and its development and transmission. 4200 w. Ill. Can Elec News—June, 1902. No. 48690.

Compounding.

A Method of Compounding Alternating Current Generators and Motors, Direct Current Generators, Synchronous Motor Generators and Synchronous Converters. Frank George Baum. Gives methods which, if intelligently applied, will give a system with very satisfactory regulation. 2800 w. Trans Am Inst of Elec Engrs—June 18, 1902. No. 49050 D.

Dynamos.

Designs for High-Speed and Slow-Speed Electrical Machines (Ueber den Entwurf Sehr Rasch—und Sehr Langsamlaufender Maschinen). Dr. F. Niethammer. A discussion of the principles of proportion and winding for dynamos and motors for various extreme speeds. 10000 w. Elektrotech Zeitschr—May 15, 1902. No. 48938 B.

Note on American Practice in Dynamo Design. Calls attention to points in design, and makes some comparison with British work in this field. 4000 w. Elec Engr, Lond—May 23, 1902. No. 48476 A.

The Design of Continuous Current Dynamos. Rankin Kennedy. Discusses an appropriate formula for a machine that will run efficiently and sparkless. 600 w. Elec Rev, Lond—May 30, 1902. No. 48646 A.

Helena, Montana.

The 50,000-Volt-Transmission Plant of the Missouri River Power Company. W. G. McConnon. An illustrated account of the project with description of the plant and line near Helena, Montana. 2000 w. Elec Rev, N Y—June 7, 1902. No. 48679.

Manchester.

Extension of the Manchester Corporation Electricity Works. An illustrated description of the new power station at Stuart-street, Bradford, an industrial suburb of Manchester, and its equipment. Also outlines the schemes in connection with this station. 5000 w. Elect'n, Lond—June 6, 1902. No. 48759 A.

Niagara Falls.

The New Generating Plants of the Niagara Falls Power Company. H. W. Buck. Illustrated description of the second plant of this company, now nearly completed, and its equipment. 3500 w. Trans Am Inst of Elec Engrs—June 18, 1902. No. 49043 D.

Parallel Driving.

Engine Requirements for the Parallel Operation of Alternators. E. M. Tingley. Read before the Engine Builders' Assn. of the U. S. Gives the specification of the Westinghouse Elec. & Mfg. Co., discussing it in detail. 2000 w. Elec Rev, N Y—May 31, 1902. No. 48541.

Some Notes on Synchronizing. Joseph Martin Roman. Discusses methods of indication, desirable conditions, the synchronizing circuit, etc. Ill. 2200 w. Elec Wld & Engr—June 14, 1902. No. 48859.

The Parallel Driving of Alternators (Ueber den Parallelbetrieb von Wechselstrommaschinen). E. Rosenberg. With especial reference to the use of gas engines as prime movers, and the necessary meth-

ods of speed regulation. 3 articles. 10000 w. Elektrotech Zeitschr—May 15, 22, 29, 1902. No. 48936 each B.

The Paralleling of Alternators. Abstract of a paper by Henry E. Longwell presented at the Pittsburg meeting of the Engine Builders' Assn., in which certain theories on the method of governing engines driving alternating generators are advanced. 1800 w. Eng Rec—June 14, 1902. No. 48793.

The Requirements for the Paralleling of Alternators as Viewed by the Engine Builders. H. E. Longwell. A discussion of this subject and the need of the electrical and mechanical engineers co-operating in solving the difficulties. 6600 w. Engr, U S A—June 2, 1902. No. 48624.

Polyphase Machinery.

Some Notes on Polyphase Machinery. A. C. Eborall. Read before the Manchester Sec. of the Inst. of Elec. Engrs. Discusses the construction and operation of standard types, giving full constructional details of modern plant of standard design. Ill. 8500 w. Engng—June 6, 1902. Serial. 1st part. No. 48776 A.

Quebec.

The Quebec-Jacques-Cartier Electric Company. Illustrated description of the power house and transmission line, etc. 1000 w. Can Elec News—June, 1902. No. 48689.

The Quebec Railway, Light and Power Company. Illustrated description of the hydraulic development, generators, stations, etc. 3000 w. Can Elec News—June, 1902. No. 48688.

Storage Batteries.

The Storage Battery in Small Central Stations. Describes the conditions in Milan, Mich., showing that by the installation of a storage battery a profitable twenty-four hour service was obtained. Ill. 1600 w. Central Station—June, 1902. No. 48699.

HEATING AND WELDING.

Electric Furnaces.

Electric Furnaces—Separation of Metals. Clinton Paul Townsend. Illustrated brief descriptions of various furnaces and methods. 700 w. Elec Wld & Engr—June 7, 1902. No. 48687.

LIGHTING.

Arc.

The Effect of Metallic Salts in the Electric Arc. G. W. Wilder. A quantitative study upon the effect of putting metallic salts into the core of the positive electrode and possibly to account for the large drop in potential at the electrodes. Ill. 3000 w. Wis Engr—May, 1902. No. 48587 D.

Incandescent.

Effect of Frequency on the Light of an Incandescent Lamp. H. Seaman. Extract from a thesis investigating the limits of frequency that will give good service. The object was to ascertain the variation in light from a 110 volt incandescent filament, for various frequencies, and to derive curves showing what is the lower limit of frequency for good incandescent lighting. 1100 w. Wis Engr—May, 1902. No. 48590 D.

Mercury Lamp.

The Cooper-Hewitt Mercury Lamp (Ueber die Quecksilberdampf-Lampe von P. C. Hewitt). Dr. Max v. Recklinghausen. A general description of the mercury vapor lamp, with data and results of tests. 4000 w. Elektrotech Zeitschr—June 5, 1902. No. 48947 B.

Rates.

Rates. Louis A. Ferguson. Read before the Nat. Elec. Lgt. Assn. A discussion of methods of charging. 1800 w. Elec, N Y—June 4, 1902. Serial. 1st part. No. 48626.

Reconstruction.

New Electric Lighting Plant for Ottawa, Canada. A. A. Dion. An illustrated description of the several stations as they are since the reconstruction made necessary by the destructive fire in 1900. 5600 w. Elec Wld & Engr—June 7. 1902. No. 48684.

Search Lights.

Modern Search Light Practice. Frank C. Perkins. An illustrated article describing various types of search lights. 1400 w. Marine Engng—June, 1902. No. 48556 C.

Street Lighting.

Street Lighting by Meter. T. D. Allin. A suggestion for the consideration of those buying electrical energy for street lighting. 1000 w. Jour of Elec—May, 1902. No. 48727.

MEASUREMENT.

Curves.

A New Curve Tracing Instrument. Prof. R. B. Owens. Illustrated description of an instrument for accurately tracing current curves in circuits of small resistance and inductance without appreciable altering their time constants, explaining its action and stating its advantages and uses for general laboratory work. 1300 w. Trans Am Inst of Elec Engrs—June 20, 1902. No. 49057 D.

Apparatus for Constructing Alternating-Current Curves (Apparat zur Aufnahme von Wechselstromkurven). R. Goldschmidt. Describing a simple instrument for drawing the curves of alternating cur-

rents. 1200 w. Elektrotech Zeitschr—June 5, 1902. No. 48948 B.

M. Hospitalier's Ondograph. Illustrated detailed description of an apparatus which registers the curves representing periodically and rapidly changing phenomena. 1800 w. Elec Rev, Lond—June 13, 1902. Serial. 1st part. No. 48869 A.

Notes on the Plotting of Speed-Time Curves. C. O. Mailloux. The object of the paper is to facilitate the use of speed-time curves as a "method of precision" by contributing certain notes of theoretical and practical observations bearing upon its analysis, or the study of its characteristics, and upon its synthesis, or the principles involved in plotting it. 14800 w. Trans Am Inst of Elec Engrs—June 19, 1902. No. 49047 D.

The Computation of the Characteristic Curves of Induction Motors (Berechnung der Charakteristischen Kurven des Induktionsmotors). A. Lindström. A discussion of the methods of Steinmetz and of Heyland and the development of an additional one. 1500 w. Elektrotceh Zeitschr—June 12, 1902. No. 48951 B.

Dynamometer.

An Electric Brake-Dynamometer (Ein Elektrisches Bremsdynamometer). A. Grau. Describing a brake used in the Technological Institute at Vienna. The energy is absorbed by the action of electromagnets upon a rotating disc. 1800 w. Elektrotech Zeitschr—May 29, 1902. No. 48942 B.

Electrometer.

The Capillary Electrometer. G. J. Burch. On the insulation resistance of the capillary electrometer and the minimum quantity of electricity required to produce a visible excursion. Read before the Royal Soc. 2000 w. Elect'n, Lond—May 30, 1902. No. 48651 A.

Insulators.

The High-Voltage Testing Laboratory of the Hermsdorf-Klosterlausnitz Porcelain Works (Die Hochspannungsversuchsstation der Porzellanfabrik Hermsdorf-Klosterlausnitz). G. Ritter. Describing the methods of testing porcelain insulators for high-transmission lines. 3000 w. Elektrotech Zeitschr—May 29, 1902. No. 48943 B.

Precision Instruments.

Notes on Modern Precision Measuring Instruments (Bemerkungen betreffend die Benutzung der Neueren Elektrischen Präcisions-Messinstrumente). W. Marek. A discussion of the calibration and use of direct-reading electrical measuring instruments. 4000 w. Elektrotech Zeitschr—May 22, 1902. No. 48939 B.

Standardization.

Report of the Committee on Standardization of the American Institute of Electrical Engineers. A revised series of recommendations on the standardization and testing of electrical apparatus. These embrace the committee's report of 1899, amended and brought up to date, and have not yet been adopted by the Institute. 6000 w. Trans Am Inst Elec Engrs—May, 1902. No. 49049 D.

Standards for Electrical Machinery and Transformers (Normalien fur Elektrische Maschinen und Transformatoren). Text of the standards proposed at the Düsseldorf meeting of the Verband Deutscher Elektrotechniker; also editorial comment. 10000 w. Elektrotech Zeitschr—June 5, 1902. No. 48945 B.

Testing Set.

A 12,000-Volt-Direct Current Testing Set. William Ambler. Illustration, with description of the apparatus recently installed in the dynamo laboratory at Sibley College. 1400 w. Sib Jour of Engng—June, 1902. No. 48834 C.

Wattmeter.

The Electrostatic Wattmeter in Commercial Measurements. Miles Walker. States the advantages of the electrostatic wattmeter, discussing the principles that underlie the design and some of its uses. Ill. 2700 w. Trans Am Inst of Elec Engrs—June 20, 1902. No. 49058 D.

POWER APPLICATIONS.

Canal Hauling.

Electrical Installation for the Soulanges Canal. Illustrates and describes the electric plant for the operation of the locks, sluices and bridges, and to light the canal throughout its entire length of about 14 miles. 2000 w. Can Elec News—June, 1902. No. 48691.

Cranes.

Electrical Wharf Cranes. Illustrated description of a set of cranes recently supplied for the Limekiln Dock, in London. 1400 w. Engr, Lond—May 23, 1902. No. 48471 A.

Haulage.

Some Notes on Electric Haulage for Mines. Discusses the plant, system, cost, locomotive haulage, etc. 2800 w. Elec Engr, Lond—June 13, 1902. No. 48868 A.

Hoisting.

Continuous-Current Motors and Apparatus for Electric Hoists (Gelijkstroommotoren en Bijbehoorende Apparaten voor Elektrisch Gedreven Hijschwerktuigen). H. Lohr. A general, illustrated discussion of the electrical equipment of cranes and other hoisting machinery. 4500 w. De Ingenieur—April 19 1902. No. 48967 D.

Induction Motors.

Some Notes on Induction Motors. H. S.

Meyer. Calls attention to points of importance in regard to asynchronous or induction motors. 2700 w. Elect'n, Lond—June 13, 1902. No. 48865 A.

Machine Driving.

Electric Driving for Mining and Workshops (Die Elektrizität im Berg und Hüttenwesen). Dr. H. Hoffmann. A review of the examples of electric driving shown at the Düsseldorf exposition. Serial. Part 1. 2500 w. Zeitschr d Ver Deutscher Ing—May 31, 1902. No. 48918 D.

Electric Equipment in Modern Machine Shop Practice. F. B. Duncan. Discusses the equipment of shops and the obstacles at present to a complete installation of electric power, indicating methods to overcome some of these obstacles. Appended is a sheet giving motor power required by a number of the standard makes of tools in general use. Brief discussion follows. 5500 w. Pro Engrs' Soc of W Penn—May, 1902. No. 48838 D.

I. The Electric Motor in Mill Work. S. S. Wales. II. Some Characteristics of Direct Current Motors. Norman Wilson Storer. Two papers somewhat connected. The first discussing applications of the electric motor, the difficulties met, etc. The second in regard to the proper selection of motors for the work required, rating of motors, etc. 5000 w. Pro Engrs' Soc of W Penn—May, 1902. No. 48836 D.

The Power Plant at the Elizabethport Shops of the Central Railroad of New Jersey. Illustrated description of an electric and compressed air station to furnish power to shops for repairing locomotives and cars. 2400 w. Eng Rec—June 21, 1902. No. 48853.

The Question of Power for Railroad Repair Shops. Paper by R. W. Stovel, read before the Ry. Club of Pittsburg, with part of the discussion, and editorial giving further information on the subject of electrical driving of machine tools and the amount of energy required for machines of different types. 5500 w. Ry & Engng Rev—June 14, 1902. No. 48849.

The Use of the Electric Motor in Modern Blast Furnace Plants. Andrew Ellicott Maccoun. Considers the applications made and the advantages gained. 2000 w. Pro Engrs' Soc of W Penn—May, 1902. No. 48837 D.

Mine Hoists.

Electrically Driven Mine Hoists (Elektrisch Betriebene Hauptschacht-Fördermaschinen). C. Köttgen. Data and results of experience with electrically operated mine hoists at Karwin, in Silesia and at Thiede, in Brunswick. Serial. Part I. 5000 w. Zeitschr d Ver Deutscher Ing—May 17, 1902. No. 48925 D.

Naval Service.

Electricity in the Navy. Lieut. Harry George. Reviews the development, noting the numerous applications for lighting and power. 14700 w. Trans Am Inst of Elec Engrs—May 28, 1902. No. 48886 D.

Electricity in the Navy. Walter M. McFarland. Discusses the adaptability of alternating current apparatus to use on shipboard, the use for lighting, power, installations on shore, etc. 3200 w. Trans Am Inst of Elec Engrs—May 28, 1902. No. 48889 D.

The Reasons for the Change of the Navy Standard Voltage from 80 to 125. Lieut. W. V. N. Powelson. Reviews briefly the history of the voltages used by the navy, and discusses the considerations that led to the recent adoption of 125 volts as the standard for all new installations on board U. S. ships. 5000 w. Trans Am Inst of Elec Engrs—May 20, 1902. No. 48884 D.

Navy Yard.

Electric Transmission of Power for Navy Yards. William S. Aldrich. An argument to show that to secure the highest efficiency electric-power transmission is best adapted to the work required. 3500 w. Jour Am Soc of Nav Engrs—May, 1902. Serial. 1st part. No. 48442 H.

Power Plant.

Power Plant of the Schwarzchild & Sulzberger Company, Chicago. Illustrated detailed description of a fine modern plant for a meat-packing establishment. 2800 w. Eng Rec—June 7, 1902. No. 48681.

Pumping.

Improvements in Electric Pumping Machinery (Neuere Ausführungen Elektrischer Wasserhaltungen). W. Philippi. Describing especially the electrically driven high speed pumps of the Riedler and Bergman type. 2500 w. 2 plates. Glückauf—June 7, 1902. No. 48961 B.

Submarine Mines.

Electricity in Its Application to Submarine Mines. Capt. John Stephen Sewell. Describes the planting of mines and the electrical arrangements. 2000 w. Trans Am Inst of Elec Engrs—May 20, 1902. No. 48887 D.

Synchronous Motors.

Notes on the Theory of the Synchronous Motor, with Special Reference to the Phenomenon of Surging. Charles Proteus Steinmetz. A mathematical study of synchronous motors and converters, in which two independent variables exist: load and field excitation. Diagrams and curves. 3000 w. Am Inst of Elec Engrs—June 18, 1902. No. 49052 D.

TRANSMISSION.

Alternating Currents.

Formula for Calculating the Electromotive Force at Any Point of a Transmission

We supply copies of these articles. See page 809.

Line for Alternating Current. M. Leblanc. Establishes a formula for giving the voltage at any point. 500 w. Trans Am Inst of Elec Engrs—June 20, 1902. No. 49051 D.

Insulation.

Energy Loss in Commercial Insulating Materials when Subjected to High Potential Stress. Charles Edward Skinner. Discusses the effects of this loss, describing some of the methods employed, and giving some of the characteristic results obtained from tests made on various materials used in commercial manufacture, and also on the insulation of finished apparatus. 5000 w. Trans Am Inst of Elec Engrs—June 20, 1902. No. 49056 D.

Lightning Arrester.

Atmospheric Electricity and Lightning Protectors. Begins a careful review of the progress made in the study of atmospheric electricity, and the various theories regarding thunderstorms. 3800 w. Engng—May 30, 1902. Serial. 1st part. No. 48656 A.

The Function of Shunt and Series Resistance in Lightning Arresters. Percy H. Thomas. A description of a method of enabling an arrester to suppress the arc which tends to follow a simultaneous discharge to ground from two legs of a circuit. 5500 w. Trans Am Inst of Elec Engrs—June 18, 1902. No. 49055 D.

Protection of Electric Plants from Atmospheric Discharges (Schutz Elektrischer Anlagen gegen Atmosphärische Entladung). A description of the Gola lightning arrester, used in Italy. 2000 w. Elektrotech Zeitschr—May 22, 1902. No. 48941 B.

Long-Distance.

The Cauveri Falls Electrical Power Transmission. An illustrated account of a long-distance transmission scheme, by which the power of these falls in Mysore, will be applied to driving mining machinery in the Kolar goldfields, nearly 100 miles away. 3000 w. Engr, Lond—June 6, 1902. No. 48778 A.

Polyphase Circuits.

An Experiment with Single-Phase Alternators on Polyphase Circuits. C. O. Mailloux. Report of an experiment at Phœnix, Arizona, April 7, 1902, demonstrating the possibility of using single-phase alternators to produce two-phase, three-phase, and direct currents. 3200 w. Trans Am Inst of Elec Engrs—June 20 1902. No. 49048 D.

Protection.

Protection of Long Distance Transmission Lines. F. A. C. Perrine. Read before the Nat. Elec. Lgt. Assn. Calls attention to means for giving the best possible protection, while admitting the imperfections. 1600 w. Elec, N Y—June 4, 1902. No. 48627.

MISCELLANY.

Education.

Concerning Uniformity in the Electrical Engineering Courses in the United States. Dr. Samuel Sheldon. Discusses the selection of the curricula, gives a table showing the maximum, the minimum and the average time devoted to various subjects in various institutions, and the aims of technical education. 1400 w. Trans Am Inst of Elec Engrs—June 21, 1902. No. 49044 D.

Presidential Address. Charles P. Steinmetz. A short outline of the writer's views of an electrical engineering course. 2000 w. Trans Am Inst of Elec Engrs—June 21, 1902. No. 49046 D.

The Education of the Elecrical Engineer. H. W. Buck. Discusses the training needed. 1300 w. Trans Am Inst of Elec Engrs—June 21, 1902. No. 49045 D.

Electric Shocks.

Electric Shocks at 500 Volts. Alexanded P. Trotter. A record of experiments and a discussion of the conditions under which shocks of 500 volts are devoid of danger. The subject is divided into three parts. (1) The physiological and electrical conditions; (2) the dangers connected with trolley wires; (3) the dangers of third rails of electric railways. 3700 w. Aust Min Stand—April 24. May 1, 1902. Serial. 2 parts. No. 48642 B.

Finances.

Massachusetts Electrical System in 1901. Alton D. Adams. A review of the finances of the electric lighting companies. 2300 w. Elec Wld & Engr—June 7, 1902. No. 48686.

Legislation.

Electricity and Legislation. The first of a series of articles proposing to show what has been the effect of legislation on the development of commercial electricity in England. 2500 w. Engr, Lond—May 30, 1902. Serial. 1st part. No. 48663 A.

Military Service.

Civilian Co-operation in the Development of Electrical Devices for Military Purposes. Caryl D. Haskins. An appeal for closer co-operation between civilian electrical engineers and the army and navy, indicating fields where they might be of service. 1200 w. Trans Am Inst of Elec Engrs—May 28, 1902. No. 48881 D.

See also Electrical Engineering, Communication.

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GAS WORKS ENGINEERING

Administration.

Some Results of American Gas-Works Administration. Discussions of American methods and the present situation of the industry. 2000 w. Jour Gas Lgt—May 20, 1902. No. 48486 A.

Bench Fuels.

Experience with Bench Fuels. W. A. Baehr. Read at meeting of the Western Gas Assn. An account of a series of experiments in Denver with the object of finding a suitable bench fuel to replace coke. Also discussion. Ill. 5300 w. Pro Age—June 2, 1902. No. 48493.

By-Product Ovens.

Cheap Gas and Fuel Without Smoke. Alton D. Adams. Describes the results obtained in gas and coke production by by-product ovens at Everett, Mass. 2700 w. Mines & Min—June 1902. No. 48673 C.

Condensation.

The Condensation of Coal Gas. Harold G. Colman. Views of the writer derived from a study of the literature of the question and his own experiments. 3000 w. Jour Gas Lgt—June 3, 1902. No. 48736 A.

Gas Coals.

Analytical Valuation of Gas Coals. Particulars from a paper by G. P. Lishman, read at London meeting of Inst. of Min. Engrs. Discusses the difficulties attending the testing of gas coal, and explaining the writer's system. 1700 w. Jour Gas Lgt—June 3, 1902. No. 48737 A.

Gas Oils.

Beaumont Oil for Gas Making. John H. Fitzgerald. Paper and discussion before the Western Gas Assn. Favorable report of its gas making qualities, with analysis. 4800 w. Am Gas Lgt Jour—June 9, 1902. No. 48695.

The Constitution of Gas Oils. Raymond Ross and J. P. Leather. Reports investigations made of the four principal oils on the market, viz., Russian, American, Borneo and Texas. 4000 w. Gas Wld—June 7, 1902. No. 48768 A.

The Prospects of the Gas Oil Trade. A statement based upon the best and latest information relating to the petroleum fields from which gas oils are drawn. 2200 w. Jour Gas Lgt—June 3, 1902. No. 48734 A.

High Pressure.

Distributing Gas at High Pressure. George F. Goodnow. Read at meeting of Western Gas Assn. Gives a comparison showing the uses to which a high pressure system may be put. General discussion. 2500 w. Am Gas Lgt Jour—June 23, 1902. No. 49006.

Distributing Gas at High Pressure. Extracts from the discussion on F. H. Shelton's paper at meeting of the Ohio Gas Lgt. Assn., in which Dr. Pole's formula was questioned. 3500 w. Gas Wld—May 24, 1902. No. 48477 A.

Hong Kong.

Hong Kong and Its Gas Works. A. J. Kennedy. An illustrated description of the works of the Hong Kong and China Gas Co., 2300 w. Gas Wld—May 24, 1902. No. 48478 A.

Legal Relations.

The Legal Relations Between Gas Supply Undertakings and Consumers. The first of a series of articles summarizing the various sections of the several Acts of Parliament which bear upon the legal relations existing between a gas undertaking and a consumer. 3000 w. Jour Gas Lgt—June 3, 1902. Serial. 1st part. No. 48733 A.

Meters.

Inspection of Gas Meters. Alton D. Adams. Reports the requirements in the state of Massachusetts, and gives the records of meters tested by the State inspector. 1000 w. Sci Am—May 31, 1902. No. 48533.

Purifiers.

Current Purifier Practice, and a New Form of Construction. F. H. Shelton. Paper before the Western Gas Assn. Briefly reviews purifier construction practice in the United States, and describes an easily made form that under some conditions will reduce the expense of construction about one-half. Ill. 6500 w. Am Gas Lgt Jour—June 9, 1902. No. 48696.

Reconstruction.

From Old Conditions to New at the Walsall Gas Works. An illustrated description of extensive improvements in these works, which have a maximum output of 2¼ million cubic feet of gas per day. 4000 w. Jour Gas Lgt—May 29, 1902. Serial. 1st part. No. 48487 A.

Retort-Houses.

Retort-Houses for Inclined Retort Settings and Their Development. Edward Drory. An account of experiments and illustrated description of the Getschiver Strasse Gas Works, and the Mariendorf Retort-House, Berlin. 2 plates. 3200 w. Jour Gas Lgt—June 3, 1902. No. 48735 A.

Water Gas.

Water Gas Manufacture in Theory and Practice. Dr. J. Kramers. Abstract trans-

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lation of a communication published last year in *Het Gas*. 2500 w. Jour Gas Lgt—May 20, 1902. Serial. 1st part. No. 48488 A.

INDUSTRIAL ECONOMY

Commerce.

Commercial Expansion. Mr. James J. Hill on the development of the United States, and the influence of the Lake Superior iron country. 4400 w. Marine Rev—June 12, 1902. No. 48843.

Dwellings.

Workmen's Dwellings at the Paris Exposition of 1900 (Das Arbeiter-Wohnungswesen auf der Weltausstellung in Paris, 1900). L. Simony. A general discussion of modern dwellings for workmen in various countries, as indicated by the exhibits at Paris. 6000 w. Zeitschr d Oesterr Ing u Arch Ver—May 23, 1902. No. 48923 B.

Education.

See Electrical Engineering, Miscellany.

Factory Office.

The Factory Office as a Productive Department. Kenneth Falconer. The concluding paper of the series, showing the close relation and special value of the factory office to the executive. 3500 w. Engineering Magazine—July, 1902. No. 48987 B.

Food Supply.

American Control of England's Food Supply. J. D. Whelpley. Concerning the dependence of England upon the United States for food, giving information of interest concerning the value of meat, grain, etc., exported, and the causes that have brought about the present conditions. 4000 w. N Am Rev—June, 1902. No. 48438 D.

Hygiene.

Shop Hygiene and Accident Prevention (Unfallverhütung und Gewerbehygiene). Dr. W. Heffter. A general discussion of the proper methods of securing the health and safety of workmen. Serial. Part I. 2000 w. Zeitschr d Ver Deutscher Ing—June 7, 1902. No. 48922 D.

Strikes.

Demands of Anthracite Coal Miners. Analysis of the causes leading to the present great strike in the Pennsylvania anthracite region. 2200 w. Eng & Min Jour—May 31, 1902. No. 48512.

Industrial History of the Anthracite Regions. R. W. Raymond. A brief review of the history of the last forty years, which furnishes the explanation to many things in present conditions. 1200 w. Eng & Min Jour—June 14, 1902. No. 48844.

Providence and Pawtucket Railway Strike. An illustrated account of the trouble caused by the ten-hour law enacted by the last Legislature. 1700 w. St Ry Jour—June 21, 1902. No. 48896 D.

Strikes in the United States. Carroll D. Wright. Reviews the history of strikes, especially those of the last twenty years, no attempt having been made until 1880 to collect data relative to labor controversies. 4000 w. N Am Rev—June, 1902. No. 48436 D.

The Anthracite Strike. R. W. Raymond. Statement of questions of permanent importance relating to this strike, some of which will be discussed in later articles. 1500 w. Eng & Min Jour—June 7, 1902. No. 48676.

Trusts.

How to Curb the Trusts. Henry Michelsen. Explains the existing state of affairs in the United States and considers the nationalization of the railways the remedy. 2800 w. N Am Rev—June, 1902. No. 48437 D.

Mr. Hill on the Railways and the Trusts. Extracts from an address before the Illinois Manufacturers' Assn., Chicago, by Mr. J. J. Hill, president of the Great Northern Ry. Thinks there is safety rather than danger in the combination of railways. 2500 w. Rv & Engng Rev—June 7, 1902. No. 48708.

Wages.

The Inefficiency of the Wages System. Discusses the inefficiency of the wages system in England and the possibility of improving or superseding it. 2800 w. Jour Gas Lgt—May 27, 1902. No. 48632 A.

Works Management.

Money Making Management for Workshop and Factory. C. U. Carpenter. Mr. Carpenter's sixth paper treats of the machining processes and the tool department, showing the productive advantages of system and method. 4000 w. Engineering Magazine—July, 1902. No. 48986 B.

The Organization of a Workshop (Organisation des Services d'une Usine). Jules Simonet. A discussion of the details of works organization with a complete scheme for the arrangement and administration of a manufacturing establishment. 10,000 w. Revue de Mécanique—May 31, 1902. No. 48911 E+F.

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MARINE AND NAVAL ENGINEERING

Armor.

Artillery *versus* Armor. Tabular report, illustrations and editorial relating to the fact recently demonstrated, that armor plate manufactured according to the latest process, has been defeated by modern guns and projectiles. 3500 w. Engng—May 30, 1902. No. 48658 A.

Barges.

Large Wooden Barges. Illustrated description of two big barges being built at Taunton, Mass. 700 w. Marine Engng—June, 1902. No. 48559 C.

Battleships.

Louis Nixon on the Battleship of the Future. Extracts from a recent article concerning the things that may affect the types of battleships. 2500 w. Marine Rev—June 19, 1902. No. 48897.

Boilers.

See Mechanical Engineering, Steam Engineering.

Cruisers.

The Steam Trials of H. M. S. "Leviathan." Gives particulars of the vessel and equipment with report of trials. 1200 w. Engng—May 23, 1902. No. 48464 A.

Docking.

The Docking of Battleships. M. Asaoka. Paper read at meeting of the Soc. of Nav. Archts. of Japan. Gives an outline description of the different operations. Interesting because of the comparison possible between Japanese and English methods. 2000 w. Engng—June 13, 1902. No. 48874 A.

Experimental Tank.

Equipment for Experimental Work on Resistance and Propulsion of Ships Installed at the Hydraulic Laboratory of Cornell University. W. F. Durand. Illustrates and describes the equipment thus far installed, stating its purpose. 2800 w. Marine Engng—June, 1902. No. 48554 C.

The Machinery of the Model Testing Tank of the U. S. Navy Department. Waldon Fawcett. An illustrated detailed description of this interesting machinery. 3000 w. Mod Mach—June, 1902. No. 48583.

The Proposed Experimental Tank for Testing Ship Models for Resistance. Gives an outline of the method of investigation by models, as devised by Mr. William Froude, and brief illustrated description of the tank at Washington. 2200 w. Nature—June 5, 1902. No. 48762 A.

Freighter.

Large American Freighter. Illustration, with description of the Alaskan, a vessel of 8671 tons, now on her way from the Pacific to the Atlantic. 1300 w. Naut Gaz—June 19, 1902. No. 48898.

Launch.

Launch with Daimler Motor for the British War Office. Illustrated description of a launch built for the British War Office, intended for use in towing targets to and from their stations during artillery practice. 700 w. Engng—May 23, 1902. No. 48462 A.

Monitors.

Early British Double-Turreted Monitors. Illustration, with an account of how these vessels, intended for the Confederate States during the Civil War, became the property of the British Government. 500 w. Sci Am—June 14, 1902. No. 48753.

Naval Warfare.

Recent Scientific Developments and the Future of Naval Warfare. William Laird Clowes. An address before the Inst. of Nav. Archts. Discusses submarines, water-tube boilers, gunnery, etc., and the importance of the trained *personnel*. 2800 w. Sci Am Sup—June 7, 1902. No. 48622.

Oil Engines.

The Application of Oil Engines to Light Marine Work. C. C. Longridge. Discusses the advantages and defects of oil motors for marine work, reversing motors, gears and propellers, bi-unial propellers, range of horse-power, etc. 2500 w. Engng—May 23, 1902. No. 48459 A.

Propeller Shafts.

Investigations upon the Dynamic Conditions in Propeller Shafts (Neue Untersuchungen über die Dynamischen Vorgänge in den Wellenleitungen von Schiffsmaschinen). H. Frahm. Describing apparatus and methods employed for the experimental record of torsional vibrations in propeller shafts. Serial. Part I. 3000 w. Zeitschr d Ver Deutscher Ing—May 31, 1902. No. 48916 D.

Repairing.

The Repairing of the Steamship Etruria. From some unknown cause the vessel lost her rudder, rudder-post, propeller and the external portion of the propeller shaft in mid-ocean. By the use of pneumatic power the repairs were executed in about two weeks. Illustrated description of the work. 1100 w. Engr, Lond—June 6, 1902. No. 48779 A.

Rolling.

The Rolling of Ships (Roulis sur Houle). H. Chaigneau. A mathematical

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study of the stresses upon the hulls of ships under the rolling action of waves. Two articles. 7500 w. Revue Technique —May 25, June 10, 1902. No. 48907 each D.

Shipbuilding.

A Comparison of Specifications for Shipbuilding Material. E. Schroedter. Abstract of a paper read before the International Shipbuilding Congress at Düsseldorf. A comparison between the conditions in Germany and Great Britain. 2000 w. Ir & Coal Trds Rev—June 13, 1902. No. 48879 A.

Shipbuilding in the United States. Alexander R. Smith. Introduction to the Census Report on Shipbuilding with continuation of last week's article. 3200 w. Naut Gaz—May 29, 1902. Serial. No. 48491.

Shipyards.

Shipyard Draughting Rooms. Theodore Lucas. An account of the work done there; the general designing of the vessels and machinery, recording, etc. 2500 w. Naut Gaz—June 19, 1902. No. 48899.

Steamboat.

New Passenger Steamboat. Illustration with description of the William G. Payne, the latest addition of the Long Island Sound fleet, built for service between New York and Bridgeport. 2500 w. Naut Gaz —June 5, 1902. No. 48635.

Steamers.

Chesapeake and Ohio Railroad Passenger Steamer Virginia. Illustrated detailed description of a twin-screw passenger boat of about 700 tons displacement. 2300 w. Marine Engng—June, 1902. No. 48553 C.

Stern Wheel River Steamer. An illustrated description of the fine steel steamer, City of Fayetteville, built for service on the Cape Fear River of North Carolina, and representing the latest type of shallow draft river steamers. 600 w. Marine Engng—June, 1902. No. 48555 C.

Steamship.

The Pacific Mail Steamship Korea. Charles K. Mallory. Illustrated description of the vessel and its equipment with report of trial. 5000 w. Jour Am Soc of Nav Engrs—May, 1902. No. 48439 H.

Wharves.

The North German Lloyd Pier-Sheds, Hoboken. Illustrated description of the steel work of the three most important piers in America, 860 to 908 feet long, and 80 to 90 feet wide. 2900 w. Eng Rec—June 21, 1902. Serial. 1st part. No. 48852.

Yachts.

Steam Yacht Oswegatchie. Brief illustrated description of a yacht for the lake region. 900 w. Marine Rev—May 29, 1902. No. 48492.

Turbine-Driven Steam Yacht "Tarantula." Illustrates and describes a very interesting yacht recently built, which is propelled by steam-turbine machinery, and fitted with Yarrow boilers. 3500 w. Engng—June 6, 1902. No. 48775 A.

MECHANICAL ENGINEERING

AUTOMOBILES.

Alcohol Motors.

Trials of Alcohol Motors. Discusses the trials from Beauvais to Paris, and alcohol as compared with petrol. 2500 w. Engr, Lond—May 23, 1902. No. 48467 A.

Alcohol Race.

The Northern Alcohol Race. An account of this race which proved that alcohol could be used with safety for vehicles running at high speeds. Ill. 4600 w. Autocar—May 24, 1902. No. 48485 A.

Alcohol Tests.

The French Alcohol Tests (Circuit du Nord). An account of the racing tests and the results, and the consumption trials and results. Also brief notice of the alcohol exhibition. 3000 w. Auto Jour—May 31, 1902. No. 48641 A.

Burners.

Bunsen and Injector Burners. J. S. V. Bickford. Experimental investigation of the class of burners in which the jet of vapor mixed with air passes through a length of tube before being ignited. Ill. 2500 w. Horseless Age—May 28, 1902. No. 48519.

Digest of Kerosene Burner Patents. F. W. Barker. Brief illustrated outlines of patents treating the subject of vaporizing kerosene and burning the vapor under a boiler. 3200 w. Horseless Age—May 28, 1902. No. 48523.

Kerosene Carburettors and Burners. L. Berger. Illustrates and describes various carburetters and burners and their principles of construction. 1200 w. Horseless Age—May 28, 1902. No. 48520.

Petroleum Vapor Burners—General Principles. J. S. V. Bickford. Aims to give the principles on which petroleum apparatus may be designed. Ill. Horseless Age—May 28, 1902. No. 48518.

Some Kerosene Burners. Illustrations

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and particulars of eight types of burners. 4000 w. Horseless Age—May 28, 1902. No. 48524.

Carburetters.

Carburetters at the Paris Alcohol Show. Brief illustrated descriptions of interesting devices. 1200 w. Auto Jour—June 7, 1902. No. 48767 A.

Fuel.

The Fuel Question. Albert L. Clough. Discusses gasoline and kerosene as fuels for automobile use. Also editorial. 2800 w. Horseless Age—May 28, 1902. No. 48515.

The Physical Properties of Gasoline and Kerosene. L. Berger. Investigation of the various properties of the two fuels. 2700 w. Horseless Age—May 28, 1902. No. 48517.

Gasoline Carriages.

The Trend of American Gasoline Carriage Practice. Albert L. Clough. A review of recent changes and the present American practice. 2500 w. Horseless Age—June 11, 1902. No. 48719.

Kerosene.

Kerosene and the Important Factors in Its Combustion. Harrington Emerson. Information concerning this product and its use in engines. 4000 w. Horseless Age—May 28, 1902. No. 48516.

Kerosene in Exploding Engines. Charles E. Lucke. The operation of the explosive kerosene engine is discussed, the importance of the maintenance of proportion in the mixture, and the effects of changes, and typical means proposed and used for obtaining mixtures of kerosene and air. 2800 w. Horseless Age—May 28, 1902. No. 48522.

Miscellaneous Methods of Kerosene Combustion. J. S. V. Bickford. Gives a description of petroleum blow-pipes, and of two types of apparatus for applying the principle of introducing steam in petroleum Bunsen burners, etc. Ill. 2200 w. Horseless Age—May 28, 1902. No. 48521.

Light Carriage.

The Georges Richard Light Carriage. Illustrates and describes a design presenting some interesting peculiarities. 1400 w. Auto Topics—June 21, 1902. No. 48851.

Omnibus.

The Fischer Omnibus. Illustrations, with description of a machine propelled by a petrol motor but having the power transmitted to the rear wheels electrically. Also account of a run. 2500 w. Auto Jour—June 14, 1902. No. 48864 A.

Petrol Cars.

The Humber 8 and 12-h. p. Petrol Cars. Illustrated detailed description of two different sized cars of a new type. 2800 w. Auto Jour—June 14, 1902. Serial. 1st part. No. 48863 A.

Prussia.

Automobilism in Prussia. Concerning the motor carriage exposition at Berlin, giving general description, and discussing progress made. 2000 w. U S Cons Repts No. 1377—June 26, 1902. No. 49032 D.

Racing Car.

The Baker Electric Racing Automobile. Illustrated description of the electric racer that was the cause of a serious accident at the Staten Island speed trials. 800 w. Sci Am—June 14, 1902. No. 48755.

Storage Batteries.

The Possibilities for a Light Weight Storage Battery. A. L. Marsh. Points out some theoretical considerations which may throw a little light on this problem so important to the electric automobile industry. 2500 w. Elec Wld & Engr—June 7, 1902. No. 48685.

Touring Cars.

Touring Car Bodies. Leon Auscher. Read before the Automobile Congress at Dijon. Considers the touring vehicle with seats for three to five persons. Ill. 2400 w. Horseless Age—June 11, 1902. Serial. 1st part. No. 48721.

Trials.

Bexhill Speed Trials. An illustrated account of these trials which recently took place at Bexhill-on-Sea, in England. 7000 w. Auto Jour—May 24, 1902. No. 48484 A.

HYDRAULICS.

Air Compressor.

The Hydraulic Air Compressor at Norwich, Conn. Herbert M. Knight. An illustrated description of this installation for the compression of air by what is known as the "Taylor System." 2800 w. Eng News—June 12, 1902. No. 48711.

Flow.

Measurement of Flow of Water in Pipes. Edward S. Cole. Describes a method devised for economically measuring the flow of water in pipes, by the use of the Pitot tube. Also a description of the photo-pitometer for recording the deflections. Ill. 1600 w. Sib Jour of Engng —May, 1902. No. 48832 C.

See Civil Engineering, Canals, Rivers and Harbors.

Pumping.

Pneumatic Pumping Appliances. W. C. Popplewell. The present article gives an illustrated description of various types of displacement pumps. 2200 w. Mech Engr—June 14, 1902. Serial. 1st part. No. 48862 A.

See Mining and Metallurgy, Mining.

Rudder Boom.

The Rudder Boom. Halbert Powers Gillette. Describes this device, which has been applied to the diverting of the drift-wood from the intake of the pipe at Snoqualmie Falls power plant, and calls attention to other uses that may be made of it. 1500 w. Eng News—June 12, 1902. No. 48712.

Turbines.

The Action of Water in Free Jet Turbines (Ueber die Wirkungsweise des Wassers in Laufrädern der Freistrahl-turbinen). Arthur Budau. An examination of the influence of the motion of a turbine wheel upon the flow of water through the buckets. 5000 w. Zeitschr d Oesterr Ing u Arch Ver—May 30, 1902. No. 48924 B.

Turbine Test.

Brake Tests on a New American Turbine (Bremsversuche an einer New American Turbine). A comparative test by Professor Pfarr of Darmstadt, with data of trials made in the flume at Holyoke, Mass. 3000 w. Zeitschr d Ver Deutscher Ing—June 7, 1902. No. 48921 D.

Water Power.

Large Water Power Plants. Gives facts concerning important plants now erected or building. 1600 w. Mach. N Y—June, 1902. No. 48629.

MACHINE WORKS AND FOUNDRIES.

Accounting.

Foundry Accounting. J. G. Stewart. Examines in detail methods of keeping records and remarks on the importance of knowing accurately the cost of work, etc. 5000 w. Jour Am Found Assn—June, 1902. No. 48805.

Bearings.

Anti-Friction Bearings. Henry R. Lordly. Gives facts relating to this subject obtained in an investigation lasting nearly one year. Ill. 5200 w. Trans Assn of Civ Engrs of Cornell Univ—1902. No. 48599 F.

Brass.

Brass Melting. Charles Vickers. Suggestions for economical melting with remarks on troubles and their remedies. 1100 w. Jour Am Found Assn—June, 1902. No. 48803.

Brass Foundry.

The New Brass Foundry of the Chicago, Rock Island & Pacific Railway Company, Chicago. Illustrated detailed description. 2200 w. Foundry—June, 1902. No. 48497.

Castings.

Foundry Tests and Malleable Iron Castings in the United States. Information in response to inquiries as to matters of detail, brought out by a series of articles recently published in this paper. 2400 w. Engr, Lond—May 23, 1902. No. 48472 A.

Scrap Metal Castings. Walter J. May. Suggestions for the use of scrap, the sorting, treatment, etc. 2400 w. Prac Engr—June 13 1902. No. 48861 A.

Chains.

The Strathern Weldless Chain Manufacture. An illustrated description of the machine and process of manufacture. 3000 w. Prac Engr—May 23, 1902. No. 48481 A.

Cores.

Cores and Core Arbors. Edward B. Gilmour. Discusses the making of cores and core arbors, the best practice, kind of material, etc. Ill. 2000 w. Jour Am Found Assn—June, 1902. No. 48808.

Cost-Keeping.

Cost Keeping and Wage Systems of the Stillwell-Bierce & Smith-Vaile Co. Descriptive articles outlining the system of the purchasing department. 2300 w. Ir Trd Rev—June 5, 1902. No. 48563.

Foundry Costs. R. C. Cunningham. Suggestions for improving the output and diminishing the costs, by supplying needed tools, careful over-sight, etc. 1700 w. Jour Am Found Assn—June, 1902. No. 48801.

Cranes.

Notes on Crane Design. A. D. Williams. Discusses the loads, stresses, strains, bending moment, etc., and the types in use. 2400 w. Am Mach—June 12, 1902. No. 48725.

The Giant Crane at Bremerhaven. Illustrated description of the crane built for the Kaiser dock in Germany. 800 w. Sci Am Sup—May 31, 1902. No. 48536.

See Electrical Engineering, Power Applications.

Cupolas.

The Effect of Melting Steel with Iron in the Cupola. H. E. Diller. Tabulated results of tests made to determine the best proportion of steel to use, and to trace the connection between the percentage of total carbon and the tensile strength. 800 w. Jour Am Found Assn—June, 1902. No. 48806.

The Metallurgy of the Cupola. H. E. Field. A study of the effects of melting upon iron, and upon the metalloids therein contained. 4000 w. Jour Am Found Assn—June, 1902. No. 48800.

Dies.

A Punching, Drawing and Forming Die. Illustrates and describes a die in constant use in a small brass factory, doing work at the rate of 12,000 to 15,000 pieces in nine hours. 1100 w. Am Mach—May 29, 1902. No. 48501.

We supply copies of these articles. See page 809.

Drawings.

Average Drawing Room Practice. C. E. Coolidge. Gives questions sent out by Prof. Barr, of Sibley College, and the replies received, with a view of forming an average system. 1600 w. Am Mach—June 19, 1902. No. 49005.

Economy.

Economy. P. R. Ramp. Calls attention to things that cause waste, and to false economy often practiced. 1400 w. Jour Am Found Assn—June, 1902. No. 48809.

Engineering Works.

Detroit Steel Car Works of the American Car & Foundry Company. Illustrated description and information concerning this recently completed plant. 2300 w. R R Gaz—June 13, 1902. No. 48738.

The Emlyn Engineering Works. Illustrated detailed description of the works at Gloucester, England and their equipment. Repairs and renewal work are carried on, and the manufacture of mortar mills, steam winches, travelling jib cranes, etc. 900 w. Engr, Lond—May 30, 1902. No. 48664 A.

The German Niles Tool Works, Berlin. Begins an illustrated detailed description of these interesting works, where American and German systems of engineering are combined. 5600 w. Engng—May 30, 1902. Serial. 1st part. No. 48655 A.

The General Scheme of the New Milwaukee Plant of the Allis-Chalmers Company. Illustrates and describes the leading features of the general scheme of one of the finest plants for machine building. 2000 w. Am Mach—June 12, 1902. No. 48724.

The Structural Steel Car Company. Brief description of the works at Canton, Ohio, and of the cars made. 2000 w. R R Gaz—June 13, 1902. No. 48716.

The Tool Equipment of French Locomotive Shops. Information from the "Official Journal of the French Republic" concerning their superannuated tools. 2200 w. Am Mach—May 29, 1902. No. 48502.

Factory Office.

See Industrial Economy.

Forgings.

Forgings for Engines. H. F. J. Porter. Read before the Engine Builders' Assn. Considers the steel-forging industry, the operations, annealing, changes in metal, crank shafts, hollow forgings, engine fittings, etc. 4500 w. Ir Trd Rev—May 29 1902. No. 48503.

The Oil-Tempering of Mild-Steel Forgings. Thomas Burt. Read before the Shanghai Soc of Engrs & Archts. A report of tests showing the marked improvement of the steel by oil-tempering, and general discussion of the subject. 3400 w. Engng—June 13, 1902. No. 48875 A.

Hoisting.

Hoisting Machinery (Die Hebezeuge). Ad. Ernst. A deschiption of the cranes and other hoisting machinery shown at the Düsseldorf exposition. Serial. Part 1. 2500 w. Zeitschr d Ver Deutscher Ing—May 24, 1902. No. 48913 D.

See Electrical Engineering, Power Applications.

Machine Tools.

Some Yorkshire Machine Tools. Illustrates and describes representative tools of some nine separate firms. 10900 w. Engr, Lond (Sup)—June 13, 1902. No. 48876 A.

Molding.

The Molding Machine Flasks. S. H. Stupekoff. The importance of good flasks and flask pins is discussed. 1400 w. Jour Am Found Assn—June, 1902. No. 48810.

The Molding Machine. S. H. Stupakoff. Jigs. Describes in detail the preparing of pattern plates and patterns for plate molding, giving drawings. 2500 w. Jour Am Found Assn—June, 1902. No. 48807.

Production.

Some Methods of Increasing Foundry Production. David Reid. Describes methods tried and proved successful. 1500 w. Jour Am Found Assn—June, 1902. No. 48804.

Reamers.

Hardening Long Reamers. E. K. Markham. An explanation of the method used by the writer with good results. 1800 w. Am Mach—May 29, 1902. No. 48500.

Repetition Work.

The Advantage of Working to Patterns and Gauges. Walter J. May. Calls attention to the advantages derived from the use of carefully made patterns and gauges in all cases where repetition work is likely to occur, especially in the foundry and smithy. 2000 w. Prac Engr—May 30, 1902. No. 48638 A.

Shop Practice.

Some Points in Shop Practice from the Cincinnati Milling Machine Company. Illustrated description of methods of interest. 2500 w. Am Mtch—June 19. 1902. No. 49004.

Shop Tools.

Shop Tools and Rigs. James A. Murphy. Calls attention to the economy of having properly equipped shops, well designed tools, etc., giving illustrated description of useful tools. 1500 w. Jour Am Found Assn—June, 1902. No. 48802.

Specifications.

Specifications for Steel Forgings and Steel Castings. William B. Webster. Of-

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fers these specifications for discussion. Gives table from Mr. C. H. Ridsdale's paper, and in appendix, the Standard Specifications for Steel Forgings and Castings. 2200 w. Trans Am Inst of Min Engrs—May, 1902. No. 48825 C.

Speed Control.

Mechanical Speed Changing Devices. Driving Machine Tools from Constant Speed Motors. H. M. Palmer, G. E. Flanagan and others. A discussion of these subjects. 4200 w. Pro Engrs' Soc of W Penn—May, 1902. No. 48839 D.

Turning.

The Flat Drill as a Turning Tool. F. W. Shaw. Describes the use of the flat drill as a turning tool, illustrating the methods for straight and circular work. 2500 w. Am Mach—June 5, 1902. No. 48562.

Tools.

Machine Tools (Die Werkzeugmaschinen). H. Fischer. A detailed review of the various machine tools shown at the Düsseldorf exposition. Serial. Part 1. 2500 w. Zeitschr d Ver Deutscher Ing—June 7, 1902. No. 48919 D.

Works Management.

See Industrial Economy.

MATERIALS OF CONSTRUCTION.

Cast Iron.

Cast Iron. Percy Longmuir. Reviews the constituent elements and their effect on the quality and the purpose to which the iron is adapted. 2800 w. Jour Am Found Assn—June, 1902. No. 48811.

The Constitution of Cast Iron, with Remarks on Current Opinions Concerning It. H. M. Howe. A discussion of this paper presented at the Richmond meeting. 2500 w. Trans Am Inst of Min Engrs—Feb. 1901. No. 48818 D.

Hardness.

Brinell's Method of Determining Hardness (Méthode de M. Brinell pour la Détermination de la Durete des Corps). A discussion of the report of Axel Wahlberg upon Brinell's method of determining hardness by the penetration of a steel ball under pressure. 3000 w. Revue Technique—June 10, 1902. No. 48908 D.

Lubricants.

Graphite Lubrication. Hugh D. Meier. Discusses various lubricants and gives tabulated results of a test made by Prof. R. H. Thurston. 1000 w. Horseless Age—June 11, 1902. No. 48722.

Piping.

Piping Materials for Steam Plants. John B. Berryman. Gives the results of a series of tests, principally covering the field of high pressure steam piping. 3300 w. Ir Trd Rev—May 29, 1902. No. 48504.

Rubber.

Recovered Rubber. Information concerning this material. 1800 w. Engng—May 23, 1902. No. 48460 A.

Testing Machine.

A Belt and Pulley Testing Machine. C. M. Allen. Describes a machine used in the engineering laboratory of the Worcester Polytechnic Institute for making a series of comparative pulley tests. 1100 w. R R Gaz—June 6, 1902. No. 48614.

MEASUREMENT.

Estimating.

Estimation of Weight and Volume. J. G. A. Meyer. Gives simple methods of finding the weights and volumes of irregular bodies. 1500 w. Mach, N Y—June, 1902. No. 48631.

Flexure.

The Determination of Unit Stresses in the General Case of Flexure. L. J. Johnson. Calls attention to methods by which the distribution of stress can be determined for any case of flexure in a straight bar. Gives fully worked numerical examples. 8500 w. Jour Assn of Engng Socs—May, 1902. No. 48893 C.

Stresses.

Stress in Chain Links. G. A. Goodenough. Gives results of an analytical investigation of the stresses in oval links, outlining the method used. 1800 w. Technograph, No. 16—1901-2. No. 48449 D.

Vibrations.

Torsional Vibrations of Shafts. L. Gümbel. Read before the Inst. of Naval Archts. A mathematical demonstration of the application of Fourier's theorem to the study of torsional vibrations of shafts of marine engines. 4200 w. Jour Am Soc of Nav Engrs—May, 1902. No. 48441 H.

POWER AND TRANSMISSION.

Air Compressors.

Types of Foreign Air Compressors. J. Walter Pearse. Illustrates and describes types from a number of foreign plants. 4000 w. Compressed air—June, 1902. No. 48891

Belt-Drive.

Belt Drive for Shafts at Right Angles. Forrest R. Jones. Illustrates and describes a graphical method of laying out a reversible, three-pulley drive. 4400 w. Mach, N Y—June, 1902. No. 48630.

Gearing.

Paper and Iron Friction Gearing. Edward C. de Wolfe. Information concerning the power, applications and service peculiarities, with diagrams to facilitate computations, and directions for their use. 2200 w. Am Mach—May 29, 1902. No. 48499.

Pulleys.

Comparative Tests of Plain and Para Pneumatic Pulleys. H. Diederichs. Reports a series of tests made in the mechanical laboratory of Sibley College. 700 w. Sib Jour of Engng—June, 1902. No. 48835 C.

Safety Devices.

Protection of Light Shafts and Safety Devices in Connection with Lift Doors and Controlling Gears. Henry C. Walker. An illustrated article considering the cases most frequently met, and the form of safety appliance best to adopt in each case. 2500 w. Prac Engr—May 23, 1902. Serial. 1st part. No. 48479 A.

Stage Mechanism.

Mechanical Engineering at the Royal Opera House, London. Illustrates and describes the stage mechanism and theatre engineering work. 2000 w. Mech Engr—June 7, 1902. No. 48763 A.

SPECIAL MOTORS.

Alcohol Motors.

See Mechanical Engineering, Automobiles.

Diesel Motor.

The New Diesel Engine. Illustrated description of a new 30-B. H. P. Diesel oil engine and its operation. 3500 w. Engr, Lond—May 30, 1902. Serial. 1st part. o. 48465 A.

Gas Engines.

Recent Developments in the Gas Engine. T. Hudson Beare. Lecture to the Graduates' Assn. of the Inst. of Mech. Engrs. Considers the improvements since 1889 in detail, and their effects. 4500 w. Engng—May 23, 1902. Serial. 1st part. No. 48465 A.

The Development of Large Gas Engines (De Opkomst der Groote Gasmotoren). Chr. Muller. A discussion of the advantages of the large gas engine, supplied with producer gas, as adapted to the industries of Holland. 3000 w. De Ingenieur—May 3, 1902. No. 48968 D.

Gasoline Engines.

Care and Management of the Marine Gasoline Engine. E. W. Roberts. Describes briefly the two types in use for marine purposes, the points bearing upon efficient working, ignition, exhaust, etc., in the present article. 2000 w. Marine Engng—June, 1902. Serial. 1st part. No. 48560 C.

Gas vs. Steam.

Gas vs. Steam Engines. Albert Stritmatter. Discusses information given on this subject in recently published articles. 1700 w. Am Mfr—May 29, 1902. No. 48494.

Ignition.

Electric Ignition. Donald M. Bliss. Remarks on the methods of ignition for gasoline motors and their merits, and the care needed in their use. 1200 w. Marine Engng—June. 1902. No. 48558 C.

Oil Engine.

See Marine Engineering.

Piston Rings.

Piston Rings of Explosive Engines—Two Methods of Manufacture. Hugh D. Meier. Describes methods of manufacture that will give perfect piston rings. Ill. 1600 w. Horseless Age—June 18, 1902. No. 49001.

Piston Rings in Gas Engine Construction. J. Edward Baldwin. Reports a series of tests made on the effect of various degrees of compression and various mixtures. 900 w. Horseless Age—June 11, 1901. No. 48720.

STEAM ENGINEERING.

Boiler Explosion.

The Penberthy Boiler Explosion. R. C. Carpenter. An account of the investigations which led to the discovery of the cause of this disastrous explosion in Detroit, Mich. 1200 w. Sib Jour of Engng—May, 1902. No. 48830 C.

Boiler Settings.

Brick Settings for Steam Boilers. From *Building News*. Calls attention to details of importance in the flues, settings, foundations, design, etc. 1600 w. Prac Engr—May 23, 1902. No. 48482 A.

Boilers.

A Defense of the Niclausse Boiler. J. & A. Niclausse. A statement correcting errors published in an earlier article concerning these boilers. 2800 w. Jour Am Soc of Nav Engrs—May, 1902. No. 48443 H.

Rational Design of Locomotive Boilers. D. Van Alstine. Calls attention to important points in the design of locomotive boilers. 700 w. Am Engr & R R Jour—June, 1902. No. 48573 C.

Review of Water-Tube Boilers Now Used for Marine Purposes, with a Comparative Reference to the Ordinary Cylindrical Type. Ernest N. Janson. Descriptive review, comparison and conclusions. 7000 w. Jour Am Soc of Nav Engrs—May, 1902. No. 48440 H.

Water-Tube Boiler for Locomotives. An illustrated description of a boiler of the locomotive type, with modifications, in use on the London and South Western Ry., England. Also describes spark-preventing apparatus. 2200 w. Engng—May 30, 1902. No. 48657 A.

Water-Tube Boiler Installations of the World's Navies. Compiled by Charles W. Dyson. A collection of all data concern-

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ing water-tube boilers that have been published, arranged in tabular form for reference. 2500 w. Jour Am Soc of Nav Engrs—May, 1902. No. 48444 H.

Corrosion.

Corrosion of Boiler Tubes. Prepared from a report made by Lieut. W. H. Chambers of a series of tests made to ascertain the relative corrodibility of lap-welded Bessemer steel, lap-welded iron, seamless cold-drawn steel and seamless hot-drawn steel boiler tubes. 4000 w. Ill. Jour Am Soc of Nav Engrs—May, 1902. No. 48445 H.

Engine Frames.

Stresses in Vertical Engine Frames (Die Ermittlung der Spannungen in den Ständern Stehender Dampfmaschinen). G. Schwarz. An analytical and graphical discussion of the stresses in the framework of vertical engines of the marine type. 3000 w. Zeitschr d Ver Deutscher Ing—May 17, 1902. No. 48926 D.

Engines.

A Comparison of Five Types of Engines. W. E. Dalby. Read before the Inst of Naval Archts. A comparison with respect to their inertia forces and couples, their increases in weight due to the addition of balance weights and the variations of turning moment on their crank shafts. 4000 w. Mech Engr—May 31, 1902. No. 48639 A.

Experiments on a Steam Engine. Bryan Donkin. An account of experiments made to test an engine in working conditions, while varving within certain limits the speed, power, pressure of steam, and amount of vacuum, and to determine the effect on the consumption and economy of the engine. 2800 w. Engr, Lond—May 23. 1002. No. 48469 A.

Growth and Development of the Steam Engine. Prof. A. W. Richter. Lecture delivered at the Buttermakers' Assn. Illustrated historical review. 4500 w. Wis Engr—May, 1902. No. 48588 D.

On the Determination of the Irregularity Factor of Engines. Dr. Rudolf Franke. A paper read before the Verband Deutscher Elektrotechnicker at Dresden. Translated from the *Elektrotechnische Zeitschrift*. Considers the disturbances to which the irregularity gives rise, the methods for determining the degree of irregularity and the meaning of this term to the electrical engineer. 2200 w. Elec Rev, Lond—Mav 30, 1902. Serial. 1st part. No. 48645 A.

Engine Test.

Investigations upon a 1000 H. P. Tandem Compound Engine (Untersuchung einer Tandem-Verbundmaschine von 1000 PS.) M. Schröter. Data and results of a test upon a Sulzer engine, using saturated and superheated steam. A steam consumption of 11.3 pounds per h. p. hour is shown. Serial. Part 1. 3000 w. 1 plate. Zeitschr d Ver Deutscher Ing—May 31, 1902. No. 48917 D.

Feed Water.

The Purification of Feed Water. From the report of C. E. Stromeyer to the Manchester Steam Users' Assn. dealing with results of an examination into the results obtained in practical working with various types of purifiers for feed water. Also his remarks on the cleaning of boilers worked without purifiers. 6500 w. Sci Am Sup—May 31, 1902. No. 48537.

Firing.

Rational Boiler Firing (Rationelle Kesselfeuerungen). F. Krull. Referring especially to internally fired boilers showing the advantages of the admission of air at the bridge wall. 3000 w. Zeitschr d Oesterr Ing u Arch Ver—May 16, 1902. No. 48932 B.

Heating.

Low Pressure Steam and Warm Water Heating from the Same Boiler (Niederdruckdampf und Warmwasserheizung von einem und demselben Kessel aus). H. Heider. With diagram showing the connections to radiators and returns to boiler. 1000 w. 1 plate. Gesundheits-Ingenieur—May 31, 1902. No. 48934 B.

Liquid Fuel.

Liquid Fuel—Boiler Firing with Oil. James W. Warren and H. T. Edgar. On the advantages of liquid over solid fuel for steam generating, method of burning, etc. 2200 w. Elec Rev, N Y—June 21, 1902. Serial. 1st part. No. 49007.

Oil as Fuel. Data from New Orleans, Mobile and other cities regarding the utility and efficiency of Beaumont oil as fuel in street railway power stations. Considers the saving secured and the oil-burning apparatus. 5800 w. St Ry Rev—June 20, 1902. No. 49021 C.

Packing.

Steam Engine Packing. A. McSwiney. Abstract of a paper read before the Birmingham Assn. of Mech. Engrs. Discusses the various classes of packings and their influence on this economy of the engine. Ill. 5500 w. Mech Engr—May 31, 1902. No. 48640 A.

Piping.

Feed Water Mains and Branches. Illustrates and describes several arrangements, discussing their advantages. 1800 w. Power—June, 1902. No. 48509 C.

Powdered Fuel.

Pulverized Fuel for Power Plants. F. G. Gasche. Stating the advantages of pulverizing low grade fuels, and giving ex-

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perimental results. 2500 w. R R Gaz—June 20, 1902. No. 49036.

Steam.

Steam: An article suggested by Mr. Stromeyer's paper on "Distortion of Boilers due to Overheating." Considers the existing state of the theory of the formation and nature of steam. 4800 w. Engr, Lond—May 30, 1902. No. 48660 A.

Steam Consumption.

The Estimation of the Steam Consumption of Engines. Explains methods of determining the quantity of steam required to develop any given horse-power. 1800 w. Prac Engr—May 23, 1902. Serial. 1st part. No. 48483 A.

Steam Heating.

A Time Limit and Dry Walls Necessary in Testing a Heating Plant. John Gormly. Read at meeting of the Am. Soc. of Heat. & Ven. Engrs. A report of data obtained while making heating tests in a new building. 1100 w. Met Work—June 21, 1902. No. 48880.

Heating a New York Residence. Illustrated description of the steam heating plant, mainly indirect, in a large house. 1700 w. Eng Rec—June 14, 1902. No. 48795.

The Heating of a New York Turkish-Russian Bath Establishment. Illustrated description of a plant, noteworthy for the filtration of the water from the swimming pool and its subsequent use in needle baths and laundry. 1500 w. Eng Rec—June 21, 1902. No. 48856.

Warming and Ventilation as Available for Public Buildings. Read at London meeting of the Inst. of Heat. & Ven. Engrs. Discusses the motive power used and the requirements of various classes of public buildings. 3300 w. Plumb & Dec—June 2, 1902. No. 48729 A.

Steam Turbine.

A Study of the New de Laval Steam Turbine (Etude Générale du Rendement des Nouvelles Turbines de Laval). M. Delaporte. A mathematical discussion of the discharge of steam and its action upon the buckets of the steam turbine. Serial. Part 1. 4000 w. Revue de Mécanique—May 31, 1902. No. 48912 E+F.

Notes on the Parsons Steam Turbine (Mitteilungen über Parsons-Dampfturbinen). With especial reference to the Parsons turbine as built by Brown, Boveri & Co. for use in Switzerland. Two articles, 2500 w. Schweizerische Bauzeitung—May 31, June 7, 1902. No. 48952 each B.

Stoking.

The Economy of Mechanical Stoking. W. W. Christie. Mr. Christie's first paper describes the leading types of mechanical stokers in actual use in Europe and America, with the principles of their operation. 3500 w. Engineering Magazine—July, 1902. No. 48984 B.

Superheating.

The Heating Value of Superheated Steam (Zur Frage des Wärmewertes des Ueberhitzten Wasserdampfes). C. Bach. Derivation of formulas for the computation of the heating power of steam superheated to various temperatures. 1000 w. Zeitschr d Ver Deutscher Ing—May 17, 1902. No. 48927 D.

The Schmidt System of Superheating Steam. Illustrated description. 2200 w. Elec Engr, Lond—June 13, 1902. No. 48867 A.

See Railway Engineering, Motive Power.

Valve Gears.

Beam Engine Valve Gears. Theodore Lucas. Calls attention to the remarkable accuracy and perfection of the steam distribution of the American beam engine, by a form of valve gear remarkably free from possibilities of derangement. Ill. 2200 w. Marine Engng—June, 1902. No. 48557 C.

MISCELLANY.

Aeronautics.

Aerial Navigation: the Progressive Development of Air Ships. Carl E. Myers. Reviews the early history of aerial navigation, tracing the progress and giving illustrated descriptions of various machines. Also describes the rain fall experiments, and gives other interesting information. 5500 w. Sib Jour of Engng—June, 1902. No. 48833 C.

Air-Ships and Flying-Machines. A. Santos Dumont. The author's views on the superiority of the air-ship to the fiying-machine, and on the subject of aëronautics in general. 3400 w. N Am Rev—June, 1902. No. 48435 D.

The Severo Air Ship Catastrophe. An account of the accident in Paris, which resulted in the death of the Brazilian inventor Severo and his aid, Mr. Saché. 1300 w. Sci Am—June 7, 1902. No. 48616.

Flow.

A Discussion of Ledoux' & Unwin's Formulæ for the Flow of Air in Pipes, with Special Reference to Heating and Ventilating. H. Diederichs. 1300 w. Sib Jour of Engng—May, 1902. No. 48829 C.

High Temperatures.

The Law of Stéfan and the Measurement of High Temperatures (La Mesure des Températures Elevées et la Loi de Stéfan). M. Féry. Describing a method of determining high temperatures by the elevation in temperature of a body exposed to radiant heat. 1200 w. Compte Rendus—April 28, 1902. No. 48965 D.

Liquid Air.

D'Arsonval on Liquid Air. An account of the interesting conference before the Société des Electriciens upon preparation and properties of liquid air, and the experiments shown. 1700 w. Sci Am Sup—June 14, 1902. No. 48757.

Refrigeration.

Recent Refrigerating Plants in Germany (Nouvelles Installations Réfrigérantes pour Brasseries en Allemagne). Describing the plants of the breweries at Ohlig, Nuremberg, Dortmund and Brunswick. 1800 w. 1 plate. Génie Civil—May 24, 1902. No. 48902 D.

Refrigeration and Refrigerating Mixtures (Kältemischungen und Kälteerzeugung). M. Grellert. A comparison of the relative advantages of refrigerating mixtures and refrigerating machinery for breweries. 2500 w. Gesundheits Ingenieur—May 31, 1902. No. 48933 B.

Water as a Refrigerating Agent. F. E. Mathews. Compares the evaporation of ammonia to that of water, giving table of comparative properties, etc. 2200 w. Ice & Refrig—June, 1902. No. 48582 C.

Seismograph.

Earthquake Recorders in America. Describes the instrument at Baltimore, and the records made by it. 500 w. Sci Am—June 7, 1902. No. 48619.

Ventilation.

The Ventilating of Domestic Dwellings. E. W. Mayner. Read at London meeting of the Inst. of Heat. & Ven. Engrs. How to obtain the best results. Discussion follows. 4500 w. Plumb & Dec—June 2, 1902. No. 48728 A.

MINING AND METALLURGY

COAL AND COKE.

Briquetting.

The Fuel Briquetting Industry in the United States. William G. Irwin. On the importance of utilizing waste coal and the methods employed, the practice in Europe and America, cause of early failures and recent progress. 5300 w. Ir Age—June 19 1902. No. 49000.

Canada.

Alberta Territory, Canada. Coal Fields on Crow's Nest Pass, Branch of the Canadian Pacific Railway. William M. Brewer. Describes the two distinct coal fields of this region, the development, extent, quality of coal, etc. 1600 w. Eng & Min Jour—May 31, 1902. No. 48513.

Coal Industry.

Development of the Coal Industry. William Gilbert Irwin. Reviews the history of this industry, the improvements in mining methods, the railway development due to this industry, the coking industry, etc. 2500 w. Gunton's Mag—June, 1902. No. 48431.

Coal Properties.

Legislation and Ownership of Coal Properties. Daniel Jones. Abstract of a paper before the South Staffordshire and East Worcestershire Inst. of Min Engrs. Discusses what legislation is needed to enable the nation to avail itself of the coal supplies existing under numberless small properties. 2700 w. Col Guard—June 6, 1902. No. 48771 A.

Coal-Washing.

The Campbell Coal-Washing Table. Clarence R. Claghorn. An illustrated description of an American washer. 1100 w. Ir & Coal Trds Rev—June 6, 1902. No. 48783 A.

Faults.

Overthrust Faults in the Somerset Coalfield. Abstract of paper by F. A. Steart, and of the discussion. Describes the disturbance and gives conclusions drawn from the study. 1500 w. Col Guard—May 30, 1902. No. 48653 A.

Illinois Coals.

The Coals of Illinois; Their Chemical Analysis and Calorific Value. S. W. Parr. A compilation of accumulated information arranged for reference. 1600 w. Technograph, No. 16—1901-2. No. 48-451 D.

Inspection.

Coal Mines Inspection in 1901. A report of the Midland district. 1800 w. Col Guard—May 23, 1902. No. 48457 A.

Coal Mines Inspection in 1901. A report of the Newcastle district concerning persons employed, output, accidents, etc. 1600 w. Col. Guard—May 30, 1902. No. 48652 A.

Japan.

Notes on the Takasima Coal Mines, Nagasaki, Japan. E. W. Nardin. Read before the Australian Inst. of Min. Engrs. Describes the occurrence and working of these coal seams, which comprise four islands near the entrance to Nagasaki harbor. Ill. 1300 w. Ir & Coal Trds Rev—June 13, 1902. No. 48878 A.

Peat.

The Utilization of Peat as Fuel. Describes a recently developed process for

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the making of peat coke, patented by Oscar Daube, and known as the "Economic Carbonization Process." Ill. 2000 w. Eng News—June 12, 1902. No. 48714.

Prospecting.

Prospecting for Coal in the Western States. Prof. Arthur Lakes. Points of resemblance and points of difference between he western and eastern coal fields. 2500 w. Mines & Min—June, 1902. No. 48672 C.

COPPER.

Assay.

The Cyanide Assay for Copper. Harry Huntington Miller. A discussion by Edward Keller of this paper which was presented at the Mexican meeting. 9000 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 48822.

The Litharge Process of Assaying Copper-Bearing Ores and Products, and the Method of Calculating Charges. Walter G. Perkins. Describes this method which has been severely tested and has never failed hitherto, in the assay of any ore or product to which it has been applied, though it may not be universally applicable. 1600 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 48824 C.

New Brunswick.

Copper Production in New Brunswick. An illustrated account of this promising mining industry near Dorchester. 1200 w. Can Min Rev—May 31, 1902. No. 48542 B.

Northern California.

The Copper Region of Northern California. J. S. Diller. Read before the Geological Soc. of Washington. An account of this region, which ranks fourth in importance in the copper-producing regions of the United States and of its ore deposits. 2500 w. Eng & Min Jour—June 21, 1902. No. 49025.

Ziervogel Process.

The Reactions of the Ziervogel Process and Their Temperature Limits. Robert Henry Bradford. Investigations of this process for extracting silver from copper mattes, to determine the conditions most favorable to the formation and those which cause the decomposition of the sulphates of iron, copper and silver respectively; and to finding out if these processes might not be made much easier by adding ferrous or cupric sulphate or an alkaline sulphate. 10200 w. Trans Am Inst of Min Engrs—Feb. and May, 1902. No. 48812 D.

GOLD AND SILVER.

Amalgamation.

The Patio Process for Amalgamation of Silver-Ores. Manuel Valerio Ortega. Notes offered as a contribution to the discovery of an exact theory concerning the patio process. 3500 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 48817 D.

Arizona.

Gold Deposits of Arizona. Joseph Hyde Pratt. Concerning the recent advance in the development of gold mining properties. Map. 1700 w. Eng & Min Jour—June 7, 1902. No. 48678.

Bendigo.

Gold Milling Practice at Bendigo. H. C. Boydell. Gives the main features of local gold milling practice, pointing out in what respects it differs from other large mining camps. 2500 w. Aust Min Stand—April 17, 1902. Serial. 1st part. No. 48628 B.

Brazilian Ores.

Notes on Brazilian Gold-Ores. Orville A. Derby. Describes features of special interest for students of the genesis of ore deposits. 2200 w. Trans Am Inst of Min Engrs—Feb. and May, 1901. No. 48819 D.

British Columbia.

The Present Position and the Potentialities of Mining in the Dry-Ore Belt of the Slocan District. W. D. McGregor. Information concerning these ores, considering them very promising. Map. 2500 w. B. C. Min Rec—June, 1902. No. 48761 B.

Cupelling.

The Losses of Silver in Cupelling with Varying Amounts of Lead and Silver. W. H. Kauffman. Reports results obtained in series of experiments made to determine losses. 600 w. Eng & Min Jour—June 14, 1902. No. 48845.

Dawson.

Conditions in Dawson. Information concerning transportation, mining, etc. 2200 w. U S Cons Repts, No. 1365—June 12, 1902. No. 48600 D.

Idaho.

The Geology of Thunder Mountain and Central Idaho. Robert Bell. An outline of the geology and topography of the region and the easiest means of access to this new gold field. 3000 w. Eng & Min Jour—June 7, 1902. No. 48677.

Klondike.

Gold Mining in Klondike. Prof. Henry A. Miers. Descriptive of the country, methods of mining, cost of living, etc. 5000 w. Pop Sci M—July, 1902. No. 49060 C.

Madagascar.

The Development of the Gold Deposits of Madagascar (Exploitation des Gisements Auriféres à Madagascar). H. Pérès. Discussing the geology of the

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Madagascar placers and the present methods by which they are worked. 8000 w. Mem Soc Ing Civ de France—April, 1902. No. 48910 G.

Nome.

Mining Conditions in the Nome Region, Alaska. Arthur J. Collier. The decreased production and the causes are discussed. 700 w. Eng & Min Jour—May 31, 1902. No. 48514.

The Gold Sands of Cape Nome. A. L. Queneau. A fully illustrated description of the beach at Cape Nome, showing the methods of working the auriferous sand. 3500 w. Engineering Magazine—July, 1902. No. 48982 B.

Placers.

Placer Mining. Nelson Blount. Describes placers and methods of working. Ill. 2200 w. Yale Sci M—June, 1902. No. 48892 C.

Transvaal.

Gold Mining in the Transvaal, South Africa. John Hays Hammond. (Revised Edition). Discusses the mining titles, general features, history and financial conditions, etc., geological features, genesis of the auriferous banket, milling, treatment, etc. Ill. 1300 w. Trans Am Inst of Min Engrs—Feb., 1901. No. 48828 D.

Gold-Mining in the Transvaal, South Africa. John Hays Hammond. A discussion of this paper contributed by Thomas Haight Leggett, London, Eng. 4400 w. Trans Am Inst of Min Engrs—Feb., 1901. No. 48816 D.

The Transvaal Mines Under the New Regime. John Hays Hammond. An estimate of the probable value of the deposits, discussing the economic and mining conditions and probable industrial life under British rule. 3000 w. Engineering Magazine—July, 1902. No. 48981 B.

IRON AND STEEL.

Antwerp.

The Antwerp Iron and Steel Works. Illustrates and describes fine works in the course of erection, to consist of a blast furnace plant, a steel works, and a complete roll-train. It will include an iron and steel foundry, workshops, a large boiler house, smithy, etc. 3000 w. Ir & Coal Trds Rev—May 30, 1902. No. 48665 A.

Blast Furnaces.

Tests of the New Blast Furnace at Askam. A report of tests made of this furnace which is designed on what are popularly known as "American lines," although various modifications were introduced to meet the conditions. 900 w. Ir & Coal Trds Rev—June 6, 1902. No. 48781 A.

Lake Superior.

The Original Source of the Lake Superior Iron Ores. J. E. Spurr. An account of the writer's investigations and the conclusions drawn. 5400 w. Am Geol—June, 1902. No. 48710 D.

Re-Heating.

The Effect of Re-Heating Upon the Coarse Structure of Over-Heated Steel. K. Frederik Göransson. States what has been accomplished in the study of this subject and reports personal investigations. 3000 w. Trans Am Soc of Min Engrs—Feb. and May, 1902. No. 48826 C.

Rolling Mill.

The New Rolling Mill Plant of the Dortmund Union (Die Neue Walzwerksanlage der Dortmunder Union). H. Brauns. A very completely illustrated description of the large reversing mill recently erected at Dortmund. 3000 w. 1 plate. Stahl und Eisen—June 1, 1902. No. 48954 D.

Slags.

Slag-Constitution. Studied by Means of the Tri-Axial Diagram with Rectangular Co-ordinates. Harrison Everett Ashley. A discussion suggested by Prof. H. M. Howe's paper, "The Tri-Axial Diagram," and Prof. H. O. Hofman's paper, "The Temperatures at which Certain Ferrous and Calcic Silicates are Formed in Fusion." 7000 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 48814 D.

Steel Rails.

A Few Remarks Concerning Steel Rails. Albert Sauveur. Remarks on paper by Sir Lowthian Bell concerning strength of rails. 1100 w. R R Gaz—June 6, 1902. No. 48610.

The Present Situation as to Specifications for Steel Rails. William R. Webster. A detailed statement of the present situation, showing the work thus far done. 1800 w. Trans Am Inst of Min Engrs—May, 1902. No. 48820.

MINING.

Arizona.

The Tombstone, Arizona, Mining District. John A. Church. A description of this most puzzling mining district. Maps and illustrations. 10300 w. Trans Am Inst of Min Engrs—Feb. & May, 1902. No. 48813 D.

Auditing.

Auditing a Mining Company's Accounts. Charles V. Jenkins. On the importance of an audit, the difficulties met and methods applicable. 6000 w. Mines & Min—June, 1902. No. 48670 C.

Bauxite.

Bauxite Mining in Georgia. A. W. Evans. Description of methods employed in mining, washing and drying the ores. Also analyses of Georgia and French ores.

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1700 w. Mines & Min—June, 1902. No. 48-667 C.

Drilling.

Core Drilling with the Davis Calyx Drill. L. V. Emanuel. Illustrates and describes this drill and the method of operating. 3500 w. Sch of Mines Qr—April, 1902. No. 48840 D.

Exposition.

Mining Appliances at the Düsseldorf Exposition (Der Bergbau auf der Düsseldorfer Ausstellung 1902). H. Hecker. Illustrating and describing especially the improved forms of mine hoisting machinery exhibited. 8000 w. 12 plates. Glückauf—May 24, 1902. No. 48958 B.

Explosions.

Safety Lamps and Colliery Explosions. Reviews reports of recent explosions given in the Blue-book recently issued, and discusses the safety lamps used in British mines. 4200 w. Engr, Lond—May 23, 1902. No. 48468 A.

Explosives.

The Evolution of Mining Explosives. Gives particulars pointing to the conclusion that the departure from gunpowder to high explosives is a failure as regards safety and a loss in the economical working of coal mines. 2600 w. Col Guard—May 23, 1902. No. 48458 A.

Haulage.

Intermediate Side Track for Tail-Rope Haulage. L. L. Logan. Illustrates and describes a plan as operated at the Slope mine at Robertsdale, Pa. 800 w. Mines & Min—June, 1902. No. 48669 C.

See Electrical Engineering Power Applications.

Hoisting.

Hoisting and Haulage in Mining Operations—A Description of the Plant on the Le Roi Mine, Rossland, B. C. Bernard MacDonald. A description of this plant and the economies affected by its operation. Ill. 11300 w. Can Hin Rev—May 31, 1902. No. 48545 B.

Hoisting Apparatus at the Erdwachs Mine at Boryslaw (Förderschachtanlage auf den Erdwachsgruben in Boryslaw). A. Lukaszewski. Describing the electric hoisting plant used at the mines at Boryslaw in Galicia, in connection with the deepening of the shaft. 2500 w. 1 plate. Oesterr Zeitschr f Berg u Hüttenwesen—June 7, 1902. No. 48956 B.

See Electrical Engineering, Power Applications.

Steam v. Electrically Driven Winding Engines. An interesting comparison made by F. Buschmann. 500 w. Ir & Coal Trds Rev—May 23, 1902. No. 48473 A.

Winding Engine at Sherwood Colliery. Illustrated description of a direct-acting Corliss winding engine. 1000 w. Ir & Coal Trds Rev—June 6, 1902. No. 48782 A.

Winding Plants for Great Depths. Hans C. Behr. Read before the Inst. of Min. & Met., London. Full paper with illustrations. An investigation of the various systems proposed. Vertical winding only is considered. 26000 w. Col Guard—May 23, 1902. No. 48456 A.

Mexico.

The Geographic and Geologic Features, and Their Relation to the Mineral Products of Mexico. Robert T. Hill. Describes the four physiographic provinces; (1) the Gulf coastal plain; (2) the Cordilleran plateau; (3) the Sonoran; (4) the Tehuantepecan province. 5400 w. Trans Am Inst of Min Engrs—June, 1902. No. 48827 C.

Mining.

Boring, Shaft Sinking and Underground Work (Tiefbohrung, Schachtabteufen, Abbau, und Grubenbetrieb). H. Herbst. Illustrating and describing the improved mining methods and apparatus exhibited at Düsseldorf. 3500 w. 5 plates. Glückauf—June 7, 1902. No. 48960 B.

Mining Machinery.

Mining Machinery of the South Sea Islands. Brief illustrated descriptions of odd types of mining devices used by natives. 1300 w. Min Rept—June 12, 1902. No. 48799.

Steam Driven Mining Machinery (Berg und Hüttenwerksmaschinen mit Dampfbetrieb). H. Dubbel. A review of the motive power machinery for mining and metallurgical uses, shown at the Düsseldorf exposition. Serial. Part 1. 2500 w. Zeitschr d Ver Deutscher Ing—June 7, 1902. No. 48920 D.

Ontario.

Eastern Ontario: A Region of Varied Mining Industries. Willet G. Miller. Calling attention to the great variety of mineral deposits which are being worked in the eastern part of the Province. Nickel and copper, gold, iron, arsenic, pyrite, corundum, mica, talc, graphite, feldspar, cement, etc.. 7300 w. Can Min Rev—May 31, 1902. No. 48544 B.

Ore-Crests.

The Mineral Crest, or the Hydraulic Level Attained by the Ore-Depositing Solutions, in Certain Mining Districts of the Great Salt Lake Basin. Walter P. Jenney. Describes observed phenomena, considering conditions attending their formation. 1600 w. Trans Am Soc of Min Engrs—Feb. and May, 1902. No. 48823 C.

Ore-Deposits.

Problems in the Geology of Ore Deposits. Prof. J. H. L. Vogt. Discussion by Walter Harvey Weed, criticizing views

in this paper which was presented at the Richmond meeting. 1200 w. Trans Am Inst of Min Engrs—Feb., 1901. No. 48821.

Pumping.

Centrifugal Pumps for Mine Work. W. R. Crane. Discusses the service for which they are adapted, and methods and principles of construction. Ill. 3800 w. Mines & Min—June, 1902. No. 48671 C.

The Pumping Machinery at the Düsseldorf Exposition (Die Wasserhaltungsmaschinen auf der Düsseldorfer Ausstellung). Dr. H. Hoffmann. Describing especially the exhibits of mining pumps and draining machinery. 3000 w. 8 plates. Glückauf—May 31, 1902. No. 48959 B.

See Electrical Engineering, Power Applications.

Rock Drill.

The Francois Rotary Rock Drill. N. Orban, in *Revue Universelle des Mines, de la Métallurgie, etc.* Describes and illustrates the three types employed at the Werister Colliery in Belgium. 1100 w. Coal Guord—June 13, 1902. No. 48872 A.

Safety Devices.

Safety Devices for Mine Hoists (Sicherung des Förderbetriebes durch Besondere Apparate). A. Schlüter. Describing improved forms of safety brakes and position indicators for deep mine hoists. 3000 w. 3 plates. Glückauf—May 17, 1902. No. 48957 B.

Safety Lamp.

Hübner's Benzine Safety Lamp (Hübner's Benzin-Sicherheitslampe). H. Rössner. The lamp is provided with a special device, enabling it to be lighted after closing. 1200 w. Oesterr Zeitschr f Berg u Hüttenwesen—May 17, 1902. No. 48955 B.

Shaft-Sinking.

Recent Shaft Sinking in Europe by the Freezing Method. Description of three shafts, 447, 456 and 787 feet deep, respectively, sunk by means of the Poetsch method. 1700 w. Eng Rec—June 14, 1902. No. 48704.

United Kingdom.

Mining Employment, Output and Accidents in 1901. A summary of the general results of the year as given in the General Report just issued. 1000 w. Col Guard—May 30, 1902. No. 48654 A.

Vancouver.

Notes on the Economic Minerals of Vancouver Island, B. C. W. F. Best. The most important economic minerals are copper, coal and iron, but gold, silver and other minerals are found. The interior has not yet been explored. 1600 w. Can Min Rev—May 31, 1902. No. 48543 B.

Veins.

Notes on the Structure of Ore-Bearing Veins in Mexico. Edward Halse. Illustrates and describes some of the characteristics of these veins. 2800 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 48815 D.

MISCELLANY.

Corundum.

Occurrence and Distribution of Corundum in North Carolina and Georgia. Joseph Hyde Pratt. Abstract from Bulletin 180 of the U. S. Geol. Survey. Illustrated description of the deposits and information concerning them. 2500 w. Sci Am Sup—June 14, 1902. No. 48756.

Education.

The Education of Mining Engineers, Surveyors, Metallurgists and Iron Metallurgists in Germany. J. J. Monaghan. A review of the mining schools and their courses. 3500 w. Mines & Min—June, 1902. No. 48675 C.

Nickel.

The Mond Process for the Extraction of Nickel (Le Procédé Mond pour l'Extraction du Nickel). Léon Guillet. A general account of the process with details of the apparatus. 2000 w. Génie Civil—May 31, 1902. No. 48905 D.

Petroleum.

A Brief Account of the Petroleum Industry (Korte Aanteekeningen betreffende Petroleum en de Petroleum-Industrie). C. L. M. Lambrechtsen Van Ritthem. Discussing especially the oil wells and petroleum industry of the Dutch East Indies. 6000 w. De Ingenieur—March 22, 1902. No. 48966 D.

Petroleum and Petroleum Vapor. J. H. Heck. A lecture before the Marine Engrs. Inst., England. Information concerning the crude oil and the various products derived from it, and their uses. 3500 w. Engrs Gaz—June, 1902. No. 48732 A.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Accidents.

Train Accidents in the United States in April. Classified list of principal accidents. 2500 w. R R Gaz—May 30, 1902. No. 48532.

Dispatching.

Car Dispatching. An illustrated article

giving an outline of the Methods employed on the Washington, Alexandria, & Mt. Vernon Ry. Dispatching is done entirely by telegraph. 2800 w. St Ry Rev—June 20, 1902. No. 49024 C.

Express Trains.

Between London and Paris. A comparison of routes, service, gradients, speed, etc., of the English and French lines. Ill. 2100 w. Transport—June 6, 1902. No. 48765 A.

Railway Accelerations—English and French. Charles Rous-Marten. Gives details of improved service on both English and French lines. 2500 w. Engr, Lond—June 6, 1902. No. 48777 A.

Management.

Railway Management and the Civil Engineer. Theodore Voorhees. Lecture before the College of Civil Engineering. Suggestions on the relation between the civil engineer and the railway management, giving notes on the general organization of a railway company. 6000 w. Trans Assn of Civ Engrs of Cornell Univ —1902. No. 48592 F.

Operation.

Progress Toward Safer Railway Operation. Editorial discussion of the record of casualty in the United States for the last 13 years as given in the annual report of the Interstate Commerce Commission. 1600 w. Eng News—June 19, 1902. No. 49029.

Resistance.

Train-Resistance. J. A. F. Aspinall. Extracts from a paper presented before the (British) Inst. of Civ, Engrs., setting forth details and results of some very elaborate experiments to ascertain the resistance of trains. Plate. 5000 w. R R Gaz—June 20, 1902. No. 49037.

Special Trains.

Express Trains at Four-Minute Intervals on an English Railway. Extract from an English paper concerning the arrangements for the extra traffic at the celebration over the coronation of the King. 900 w. Eng News—June 12, 1902. No. 48717.

Statistics.

Ton-Mile Basis for Engine Service Statistics. Gives a form of locomotive and car performance sheet devised by Jno. M. Taylor of the Illinois Central R. R., with remarks on the completeness in detail, etc. 000 w. Ry & Engng Rev—June 14, 1902. No. 48847.

Train Service.

The London and Northwestern Company's Accelerated Train Services. Information concerning improved service between London, Manchester and Liverpool, and between Wolverhampton, Birmingham and London. 2500 w. Transport—May 30, 1902. No. 48637 A.

Train Speed.

Concerning the Cost of Train Speed. Editorial discussion of the importance of the speed of freight trains, and the chance for economy. 1400 w. R R Gaz—June 13, 1902. No. 48749.

Tyrol.

The Railway Question in the Northern Tyrol (Die Nordtirolische Eisenbahnfrage). Victor Witasek. A review of present and projected railways in the northern Tyrol, showing the necessity for improvement. 4000 w. Zeitschr d Oesterr Ing u Arch Ver—May 16, 1902. No. 48931 B.

MOTIVE POWER AND EQUIPMENT.

Boilers.

See Mechanical Engineering, Steam Engineering.

Brakes.

Report of Committee on High Speed Brakes. Report, with illusrated description of automatic reducing valve and general dimension. 13500 w. Cent Ry Club —May, 1902. No. 48731 C.

Car Design.

The Course in Car Design at Purdue University. William Forsyth. A description of the course as conducted during the fall term of 1901. 2400 w. R R Gaz—June 13, 1902. No. 48747.

Cars.

Advantages and Disadvantages of Standard Box Cars. H. H. Perkins discusses what is regarded as the standard car, and their loads and handling. General discussion follows. 4000 w. Cent Ry Club—May, 1902. No. 48730 C.

Combined Tank and Gondola Car. Illustrates and describes a car designed with the object of providing a tank car which will hold and carry the maximum weight of liquid, and which when empty may be utilized as a flat or box car for transporting freight. 800 w. Ry & Eng Rev—June 25, 1902. No. 49018.

50-Ton Steel Coal Car (Vanderbilt Type): West Virginia Central & Pittsburg Ry. Illustrates and describes the design and construction of hopper-bottom coal cars. 800 w. Eng News—June 19, 1902. No. 49031.

Four-Wheeled Cabin Car. Southwest System Pennsylvania Lines. Detailed drawings and description of a recently designed car for freight train crews, making their quarters more comfortable and commodious. 1100 w. Ry & Engng Rev—June 14, 1902. No. 48846.

Modern Car Design. C. A. Seley. Considers the general principles of importance in this line of engineering. 2000 w. Am Engr & R R Jour—June, 1902. No. 48574 C.

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100,000 Lbs. Capacity Steel Ore Cars for the Great Northern Ry. Illustrated detailed description of design from which 300 cars have been ordered. 1800 w. Ry & Engng Rev—June 14, 1902. No. 48850.

Self-Dumping Cars in Railroad Construction. Day Allen Willey. An illustrated article on the remarkable work done by these cars in the building of railroads. 900 w. Sci Am—June 7, 1902. No. 48618.

60,000 Lbs. Capacity Logging Car, A. T. & S. F. Ry. System. Illustrated description of cars built for service in the lumber districts of Northern Texas. 900 w. Ry & Engng Rev—June 21, 1902. No. 49019.

Continental Practice.

Features of Continental Locomotive Building. Chas. R. King. Mr. King's second paper illustrates and discusses very fully the locomotives of Italy and Austria-Hungary. 4500 w. Engineering Magazine—July, 1902. No. 48985 B.

Couplers.

A Diagnosis of M. C. B. Coupler Defects, Based on Results Obtained in Service. R. D. Smith. Gives statistics concerning couplers and their performance, showing the comparative strength of the different parts of the mechanism. General discussion follows. 6800 w. W Ry Club—May 20, 1902. No. 49002 C.

Draft Gears.

Some Modern Draft Gears. Brief illustrated descriptions of various types. 1200 w. R R Gaz—June 13, 1902. No. 48745.

Report of Committee on Draft-Rigging in Relation to the Whole Cars. Report and general discussion. 4700 w. W Ry Club—May 20, 1902. No. 49003 C.

Road Tests of Spring and Friction Draft Gears. Remarks on the tests on the Lake Shore & Michigan Southern, and the Bessemer and Lake Erie, made with a view to determine the amount of shocks in ordinary service, the amount in rough and extreme service, and the behavior of the two types of gears. Conclusions from the results. 2200 w. R R Gaz—June 13,1902. No. 48741.

Firing.

Locomotive Firing. T. J. Hoskins. The present article discuss s theoretical and practical points, and the science of light and heat. 1500 w. Loc Engng—June, 1902. Serial. 1st part. No. 48567 C.

Locomotives.

Atlantic Type Fast Passenger Locomotive. Illustrated detailed description of Class E2 fast passenger locomotive. 1200 w. Am Engr & R R Jour—June, 1902. No. 48580 C.

Balancing Locomotives. W. E. Dalby. A formal proof that the only force acting to constrain the motion of a balance-weight in its trochoidal path, passes through the center of the axle, and therefore the balance-weights have no effect on the crank-axle. 900 w. Engng—June 13, 1902. No. 48873 A.

Baldwin Decapod for the Santa Fe. Illustrated detailed description of a powerful engine for freight service on the mountain division of this road. 1700 w. Ry Age—May 30, 1902. No. 48510.

Building of American Locomotives. The present article deals with the Baldwin Locomotive Works. Ill. 2400 w. Sci Am—June 7, 1902. Serial. 1st part. No. 48617.

Competitive Locomotive Types for the Illinois Central. Illustrates and describes two designs by Mr. William Renshaw, of the wide firebox type for passenger service. Their performance is to be carefully watched to determine which of the two to adopt for general use. 1500 w. R R Gaz—June 20, 1902. No. 49033.

Decapod Tandem Freight Locomotive. Illustrated description of this locomotive for the A. T. & S. F. R. R. which is supposed to be the most powerful in the world. 600 w. Am Engr & R R Jour—June, 1902. No. 48581 C.

Duplex Tank Locomotive. Illustration and brief description of a trial locomotive on the Mallet system for use on French railways. 500 w. Engr, Lond—May 23, 1902. No. 48470 A.

Good Work of a Tandem Compound. Report of engine No. 1705 on the Baltimore & Ohio R. R. 600 w. Loc Engng—June, 1902. No. 48565 C.

Large Modern Locomotives—Repairs and Loading. William McIntosh. Discusses these points in their relation to the greatest economy and the best results. 900 w. Am Engr & R R Jour—June, 1902. No. 48577 C.

Locomotive Traction Increasers. Edward Grofstrom. Discussion of the types recently put into service on the Atchison, Topeka & Santa Fe. 1000 w. Am Engr. & R R Jour—June, 1902. No. 48576 C.

New Locomotive Equipment for the St. Louis & San Francisco R. R. Illustrated detailed description of the three types of engines most recently constructed. 1600 w. Ry & Engng Rev—June 21, 1902. No. 49016.

New Power for the Frisco System. Illustrates and describes two types of engines recently built. A consolidation and a 10-wheel passenger, in which as many castings and forgings as possible are made interchangeable. 1000 w. Ry Age—June 13, 1902. No. 48796.

New Suburban Engines of the Central Railroad of New Jersey. Illustrated de-

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scription of engines of the Prairie type having features of interest. 1200 w. R R Gaz—June 20, 1902. No. 49034.

Notes on Some Twentieth Century Locomotives. Charles Rous-Marten. Paper read before the Soc. of Engrs. Indicates the writer's opinion of what appear to be some of the most prominent, interesting and important features in the locomotive practice of this century so far as it has yet gone. 4500 w. Mech Engr—June 7, 1902. Serial. 1st part. No. 48764 A.

Repairing Locomotives by Schedule. A detailed description of the scheme in use at the Chicago shops of the Chicago & Northwestern with one of the schedules. 1600 w. R R Gaz—June 13, 1902. No. 48744.

Roumanian Locomotives. Illustrated description of the standard type of goods engine for the Roumanian State Railways. 600 w. Engng—June 6, 1902. No. 48774 A.

Should Railroads Design Their Own Locomotives? F. F. Gaines. Answers the question in the affirmative (conditionally), and discusses details frequently overlooked by builders. 1600 w. Am Engr & R R Jour—June, 1902. No. 48575 C.

Six-Wheeled Coupled Bar-Frame Passenger Locomotive for the Cape Government Railways. Illustrated description, with two-page plate. 800 w. Engng—May 23, 1902. No. 48463 A.

The Advantages of an Oil Burning Locomotive. G. B. Von Boden. Concerning the arrangements for burning the oil and methods for successful operating, with statement of the advantages. 1200 w. Loc Engng—June, 1902. No. 48569 C.

The Largest Geared Locomotive Yet Built—El Paso & Rock Island Route. General view, with description and general dimensions. 1500 w. Ry & Engng Rev—June 14, 1902. No. 48848.

The N. Y. C. Traction Increaser. Illustrated description of the mechanism as given by George S. Hodgins. 2000 w. Loc Engng—June, 1902. No. 48566 C.

Two-Cylinder Compound Consolidation for the Wheeling and Lake Erie R. R. Illustrates and describes an engine designed to burn bituminous coal and for a working boiler pressure of 200 lbs. 1000 w. Ry & Engng Rev—June 7, 1902. No. 48707.

Oil Fuel.

Oil Fuel for Locomotives. Concerning the application of oil fuel to the Hoosic Tunnel helping locomotives by the Boston & Maine Railroad, with the object of keeping the tunnel clear of smoke from the coal-burning engines. 1200 w. Am Engr & R R Jour—June, 1902. No. 48579 C.

Rolling Stock.

Standards for Locomotives and Cars. Concerning the standardizing of equipment on the "Harriman Lines." Ill. 800 w. Am Engr & R R Jour—June, 1902. No. 48572 C.

Staybolts.

Staybolt-Breakage. A report kept during the year 1901, by a southwestern railroad of the breakage of staybolts in order to determine the influence of the water on this breakage. Illustrations showing the location of the broken staybolts. 2000 w. R R Gaz—June 13, 1902. No. 48739.

Superheating.

The Application of Superheated Steam to Locomotives (Applications de la Vapeur Surchauffée aux Locomotives). T. Barbier. Discussing especially the experiments made with the Schmidt System on locomotives built by Borsig for the Prussian State Railways. 2000 w. 1 plate. Génie Civil—May 31, 1902. No. 48904 D.

Superintendence.

The Superintendent of Motive Power and What Is Expected of Him. A general discussion of his responsibilities and requirements and how best to fit him for his work. 3400 w. R R Gaz—June 13, 1902. No. 48742.

Wheels.

Cast Iron Wheels Under Heavy Cars. Information obtained by recent investigations, confirming the opinion that with proper materials and design and correct methods of manufacture the cast-iron wheel may be made adequate for any service now required. Ill. 3000 w. R R Gaz—June 13, 1902. No. 48743.

Some Experience with Special Wheels in Heavy Service. P. H. Griffin. States experience of a company having a reputation for special wheels for exacting service, and shows the effect of manganese in promoting the class of fractures which have given alarm. 1500 w. R R Gaz—June 13, 1902. No. 48748.

NEW PROJECTS.

Asia.

Railroad Development in Asia. Compiled by C. T. Mason. Information of what has already been done, and what it is proposed to accomplish in India, Asiatic Russia, Asia Minor, China, and Indo-China. 1700 w. Sci Am Sup—June 21, 1902. No. 49012.

Borneo.

Railway Enterprise in British North Borneo. Map with illustrated description of a recently opened line and account of the scheme for a trans-Borneo line to terminate at Cowie Harbor. 1000 w. Engr, Lond—May 30, 1902. No. 48662 A.

We supply copies of these articles. See page 809.

Cuba.

Railroads in Cuba. Waldon Fawcett. An illustrated account of the existing and prospective lines. 1500 w. Sci Am—May 31, 1902. No. 48535.

The New Cuban Railroad. Waldon Fawcett. An illustrated account of the project now being carried out, for the construction of a complete railroad system throughout the length of the island. 1200 w. Loc Engng—June, 1902. No. 48570 C.

Indiana.

A New Railway Between Chicago and Cincinnati. Illustrated description of a nearly completed line about 30 miles shorter than existing routes. 1600 w. Eng News—June 19, 1902. No. 49028.

Ottoman Empire.

The Persian Gulf Railway. A brief account of the alternative routes which have been from time to time put forward, and their engineering merits and demerits. Map. 2400 w. Engng—June 6, 1902. Serial. 1st part. No. 48773 A.

Russia.

The Connection of the Central Railway of Asia with the European Russian System (Die Verbindung der Mittel-Asiatischen Eisenbahn mit dem Russisch-Europäischen Eisenbahnnetz). An account of the new line to connect Tashkent and Orenburg and unite the Trans-Caspian system with Europe. 1000 w. Glasers Annalen—June 1, 1902. No. 48900 D.

PERMANENT WAY AND FIXTURES.

Curves.

A Problem in Railroad Curves. Malverd A. Howe. Mathematical demonstration. 700 w. R R Gaz—June 20, 1902. No. 49038.

Suggestions for a Uniform Practice in Fixing the Lengths of Spiral Curves. W. D. Taylor. Gives tables connecting the degree of curve, amount of superelevation, the maximum velocity and lengths of spiral, with suggestions for making an economical adiustment. 2000 w. Wis Engr—May, 1902. No. 48589 D.

Engine House.

New Engine House on the Boston & Maine at East Cambridge. Illustrated description. 900 w. R R Gaz—June 13, 1902. No. 48740.

Improvements.

Jacques Cartier Cut-off. John David Black. Illustrates and describes details of an improvement made on the Quebec, Lake St. John railway. 1400 w. Can Engr—June, 1902. No. 48634.

Shops.

Chicago & Northwestern Shop Enlargements at Chicago, Ill. An illustrated account of the extensive improvements being made. 1800 w. Ry Age—May 30, 1902. No. 48511.

Mexican Central Shops at Aguascalientes, Mex. An account of improvements at this place with description of the new shops and their equipment. Ill. 1000 w. Ry Age—June 6, 1902. No. 48693.

Michigan Central Shops at Jackson, Mich. Illustrated description of extensive improvements being made. 1200 w. Ry Age—June 20, 1902. No. 49014.

Pennsylvania Division Shops of the N. Y. C. & H. R. R. R. Gives list of new installations, and illustrated description of shops at Oak Grove, Penn., for locomotives and freight car repairs. 2500 w. Ry & Engng Rev—May 31, 1902. No. 48507.

Progress in Locomotive and Car Shop Plans. Editorial comments on the great improvement shown in recently built shops, calling attention to points of interest. 2600 w. R R Gaz—June 20, 1902. No. 49039.

Suggestions Concerning Locomotive Erecting Shops. C. H. Quereau. Remarks presented with the view of stimulating study and investigation. 1200 w. Am Engr & R R Jour—June, 1902. No. 48578 C.

The Baring Cross Shops of the St. Louis, Iron Mountain & Southern Railway. Illustrates and describes this new plant, calling attention to the symmetry and convenience of the track and building arrangements. 3000 w. Ry Age—June 13, 1902. No. 48797.

The Cedar Lake Shops of the Minneapolis & St. Louis R. R. Illustrated description of shops of interest because of their location, and local conditions, and for their labor-saving devices. 4000 w. Ry & Engng Rev—June 21, 1902. No. 49017.

The Hannibal Shops of the Chicago, Burlington & Quincy Railroad. Illustrated detailed description of the recently completed shops and their equipment. 4300 w. St. Louis Ry Club—May 16, 1902. No. 48498.

The Roanoke Shops of the Norfolk & Western. Brief description of extensive improvements, involving a complete change in the power plant. 1300 w. R R Gaz—June 20, 1902. No. 49035.

Signals.

Mechanical Fog Signal Appliance. Illustrates and describes Pindar's apparatus which places detonators on the rails by mechanical means. If necessary the detonator may be withdrawn when the engine is within a foot of it. 1000 w. Engr, London—June 6, 1902. No. 48780 A.

Station.

Passenger Transfer Station at Phila-

We supply copies of these articles. See page 809.

delphia, Pennsylvania R. R. Plan and brief description of improvement of terminal facilities. 500 w. Eng News—June 12, 1902. No. 48713.

Steel Ties.

Steel Ties Coming. Remarks on the growing scarcity of wood, and its displacement by steel, with brief notice of works being erected for the manufacture of steel ties on a large scale. 900 w. Loc Engng—June, 1902. No. 48571 C.

Switch Renewals.

Crossing and Slip Switch Renewals on the Chicago and Western Indiana R. R. Illustrates and describes improvements in certain features of slip switch design, and the interesting methods pursued in the work of renewal. 1400 w. Ry & Engng Rev—May 31, 1902. No. 48506.

Versailles.

The New Line from Paris to Versailles (Nouvelle Ligne de Paris à Versailles). A. Dumas. A description of this new section of the Western Railway of France, with especial reference to the construction of the Meudon tunnel. 4000 w. 1 plate. Génie Civil—June 7, 1902. No. 48906 D.

TRAFFIC.

Freight.

Freight Transfer Houses and Consolidation of Picked-Up Freight. Edwin H. Lea. Gives suggestions which the writer feels would materially improve the present service. 2000 w. R R Gaz—June 20, 1902. No. 49040.

Handling Merchandise Freight on British Railroads. Outlines the conditions of freight service in Great Britain, and gives an account of recent changes made at Crewe by the London & Northwestern Ry. 1500 w. R R Gaz—June 6, 1902. No. 48612.

Railroad Freight Handling in New York City. Illustrated description of the system of lightering in New York harbor, method of handling the cars, etc. 1000 w. Sci Am—June 14, 1902. No. 48754.

Interstate Commission on the Right to Route Freight. The conclusions of the majority opinion, and the dissenting opinion of Chairman Knapp, are given practically in full, in the cases regarding the right of carriers to control the routing of shipments of fruit. 5000 w. Ry Age—June 6, 1902. No. 48692.

Per Diem.

"Per Diem" Runs Against the First Snag. Discussing the action of the Boston & Maine, and New York, New Haven and Hartford roads concerning the transportation of cotton. 2000 w. Ry Age—June 20, 1902. No. 49013.

Rates.

The Nebraska Maximum Rate Decision. S. M. Hudson. A study of this decision concerning the justness of certain rates. 2600 w. Ry Age—June 6, 1902. No. 48694.

MISCELLANY.

Historical Review.

Early History of the Delaware, Lackawanna & Western Railroad and Its Locomotives. Herbert T. Walker. This road is a consolidation of a number of short railroads, and it is proposed to take up each separately, showing the growth of the system from the smallest beginnings, and also the development of the locomotives. Ill. 5200 w. R R Gaz—May 30, 1902. Serial. 1st part. No. 48530.

Testing Laboratory.

The Relation of a Testing Laboratory to a Large Railway System. J. C. Thorpe. An account of the work of a railway laboratory, showing its relation to the railway system, and hence its value. 1600 w. Technograph—No. 16—1901-2. No. 48447D.

Timber Preserving.

The Timber Preserving Plant of the Great Northern. Illustrations and information concerning one of the largest preserving plants in the country, having a capacity of 4,000 ties a day. Located on Flat Head Lake, Montana. 1600 w. R R Gaz—May 30, 1902. No. 48531.

STREET AND ELECTRIC RAILWAYS

STREET RAILWAYS AND TRAMWAYS.

Acceleration Tests.

Comparative Acceleration Tests with Steam Locomotive and Electric Motor Cars. B. J. Arnold and W. B. Potter. A report of tests for determining the comparison on short-haul suburban passenger service, in connection with the preparation of a report on the use of electricity for their propulsion in the tunnel entrances and terminal in New York City. Ill. 2000 w. Trans Am Inst of Elec Engrs—June 19, 1902. No. 49042 D.

Air Resistance.

Results of Tests for Air Resistance on the Berlin-Zossen Experimental High Speed Line. Gives curves showing the relation between air pressure and speed, with account of tests. 1300 w. St Ry Jour—June 7, 1902. No. 48551 D.

We supply copies of these articles. See page 809.

Berlin.

The Berlin Metropolitan Railway (Métropolitain Electrique de Berlin). H. Martin. Illustrating and describing especially the power station and the rolling stock of the Berlin electric railway. 2500 w. 1 plate. Génie Civil—May 17, 1902. No. 48928 D.

Brake.

Electric Brakes for Street Railway Cars (Die Elektrische Bremsung der Strassenbahnwagen). M. Müller. Giving a number of diagrams showing the action and advantages of electric brakes on tramways. 6000 w. Elektrotech Zeitschr—June 12, 1902. No. 48950 B.

Bridge Connections.

East River Bridges Connecting Line. Julius Meyer. Extracts from an address delivered before the Board of Rapid Transit Commissioners discussing the requirements of this line. 900 w. R R Gaz—June 6, 1902. No. 48611.

Connecticut.

Steam, Trolley and Third Rail in Connecticut. Clarence Deming. Discusses problems of electric transportation as affected by the peculiar conditions of this state, especially the developments of the past year. 2100 w. R R Gaz—June 6, 1002. No. 48608.

Electric Traction.

Electric Traction on Roads and Mineral Railways. W. R. Cooper. Discusses whether the cost will make it advantageous to use as a means of transporting from mines to railroads. 1800 w. Ir & Coal Trds Rev—June 6, 1902. No. 48785 A.

Mechanical Engineering of an Electric Railway. H. P. Quick. A general review of the administrative and maintenance departments of an electric traction system, based upon the operation of the transport systems of Boston, Mass. 4000 w. Engineering Magazine—July, 1902. No. 48983 B.

The Cost of Electric Traction. Editorial review of a recent paper by Prof. C. A. Carus-Wilson under the title of "Electrical Traction on Steam Railways in Italy." 2500 w. Engng—May 30, 1902. No. 48659 A.

Elevated Railroad.

The Elevated Structure of the Atlantic Avenue Improvement, Brooklyn. Illustrated description of the steel-work designed for the improvements made to remove the Long Island Railway tracks from the surface. 3000 w. Eng Rec—June 17, 1902. No. 48682.

The Elevated Structure of the Atlantic Avenue Improvements. Discusses some of the peculiar features in the design of elevated railways in Brooklyn. 1200 w. Eng Rec—June 14, 1902. No. 48786.

Europe.

Electric Railway Practice on the Continent of Europe. Heinrich Vellguth. An illustrated article giving important information relating to the electric railway practice of Germany, France, Switzerland, and Holland. 2200 w. St Ry Jour—June 7, 1902. No. 48547 D.

Express Service.

Electric Freight and Express Service for Eastern Ohio. An illustrated account of the methods which have proved successful on the Cleveland and Eastern Ry. 2500 w. St Ry Jour—May 31, 1902. No. 48489 D.

Freight Business.

Freight Business on the Chicago, Harvard & Geneva Lake Railway. An illustrated article indicating the volume and kind of business in a farming community and related matters of interest. 2000 w. St Ry Jour—June 7, 1902. No. 48550 D.

Handling Crowds.

Handling Traffic at the Inter-State and West Indian Exposition, Charleston, S. C., Jan. 1 to May 31, 1902. Describes the arrangement made to accommodate the public and meet the conditions, and gives a comparative statement of earnings and expenses. Ill. 3500 w. St Ry Rev—June 20, 1902. No. 49020 C.

High Speed.

The Speed Tests on the Military Railway between Marienfelde and Zossen (Die Versuchsrfahrten auf der Militäreisenbahn zwischen Marienfelde und Zossen). H. Lochner. Data and results of the trials of September to November, 1901. Speeds of 130 Kilometres per hour were attained. Two articles, two plates. 7500 w. Glasers Annalen—May 15, June 1, 1902. No. 48929 each D.

Italy.

Electric Traction on Steam Railways in Italy. Prof. C. A. Carus-Wilson. Read before the Inst. of Elec. Engrs. An account written from an economic rather than from a technical standpoint, of what is being done toward providing, by means of electricity, a service of short trains, running frequently at high speeds, with some comparisons between the conditions of railway working in Italy and in England. Ill. Discussion. 8000 w. Elec. Engr, Lond—May 30, 1902. Supplement. No. 48648 A.

Monthly Reports.

The Street Railway Monthly Report. C. Nesbit Duffy. Suggestions from the writer's experience and practice as to the preparation, scope and arrangement of the monthly report. 3500 w. St Ry Jour—June 7, 1902. No. 48548 D.

We supply copies of these articles. See page 809.

Mountain Railways.

Light Mountain Railways. George B. Francis. A compilation of references and facts covering the location of the information, together with a statement regarding the gauge, grade, curvature, and weight of rail on quite a number of existing railroads. 2500 w. Jour Assn of Engng Socs—May, 1902. No. 48894 C.

The Electric Road of Berthoud-Thoune, Switzerland. Describes a mountain line using the three-phase low-tension electric current, with illustrated descriptions of the rolling-stock. 2000 w. Sci Am—June 14, 1902. No. 48751.

Oldham.

Oldham Corporation Electrical Tramways. History and illustrated description of these recently opened lines. 2500 w. Elec Engr, Lond—May 30, 1902. No. 48649 A.

Polyphase.

Some Notes on European Practice in Electric Traction with Three-Phase Alternating Currents. Carl L. De Muralt. Abstract of a paper before the Am. Inst. of Elec. Engrs. Gives facts showing the present standing of polyphase electric traction, with illustrated description of motors and car equipments. Also editorial comment. 7200 w. St Ry Jour—May 31, 1902. No. 48490 D.

Power Facilities.

Increased Power Facilities for the United Railways & Electric Co., of Baltimore, Md. Illustrates and describes extensive improvements being made which will considerably increase the generating and distributing capacity. 3300 w. St Ry Rev—June, 20, 1902. No. 49023 C.

Power Investigations.

Method of Ascertaining by Means of a Dynamometer Car the Power Required to Operate the Trains of the New York Central & Hudson River Railroad Between Mott Haven Junction and Grand Central Station, and the Relative Cost of Operation by Steam and Electricity. Bion J. Arnold. Report of the investigation made. Ills. & records. 6500 w. Trans Am Inst of Elec Engrs—June 19, 1902. No. 49041 D.

Railway Motors.

A Study of the Heating of Railway Motors. A. H. Armstrong. A study of some of the variables met with and their influence upon the motive power and station output for the higher as well as the lower speed schedules. 6000 w. Trans Am Inst of Elec Engrs—June 20, 1902. No. 49051 D.

Rapid Transit.

Interborough Rapid Transit in New York City. Editorial discussion of questions in relation to a complete interborough system of underground passenger railways, and the powers of the Rapid Transit Commission. 2000 w. Eng News—June 5, 1902. No. 48705.

Signals.

Automatic Block Signals for Electric Railways. Editorial discussion of the need of such systems, considering proposed schemes. 1500 w. St Ry Jour—June 7, 1902. No. 48549 D.

Standard Railways.

Electric Traction and Standard Railways. E. Huber. Gives details regarding the experiments made by the Oerlikon Company, briefly describing the system and showing its advantages over existing systems. 3500 w. St Ry Jour—June 7, 1902. No. 48552 D.

Stray Currents.

Electrolysis of Underground Metals. J. M. Humiston. Explains the action, cause and means of protection. Ill. 4000 w. Pro Age—June 16, 1902. No. 48798.

Street Cars.

The Sanitary Condition of Street Cars in New York. George A. Soper, in *Medical News.* The effects of poor ventilation, bacterial condition of the air in cars, and the condition in tunnels and subways are discussed, and the need of laws to prevent overcrowding, spitting, and proper ventilating and warming. 4000 w. Sanitarian—June, 1902. No. 48666 D.

Surface Contact.

A New Surface Contact Tramway System. From *Le Genie Civil.* Brief illustrated description of the novel features of the invention of M. Cruvellier. 1300 w. Engr, Lond—June 13, 1902. No. 48877 A.

Surface-Contact Electric Traction System (Traction Electrique par Contact Superficiel). A description of the Cruvellier system in which two insulated conductors are used. 1200 w. Génie Civil—May 24, 1902. No. 48903 D.

Tramways.

Doncaster Electric Tramways. History of the undertaking, with illustrated description of the equipment, generating works, etc. 2500 w. Elec Engr, Lond—June 6, 1902. No. 48769 A.

Undergrounds.

The Whitechapel and Bow Railway. Illustrated description of the last of the London "undergrounds," and an account of the opening ceremonies. 4000 w. Transport—June 6, 1902. No. 48766 A.

Electric Underground Railways in London. A descriptive summary of the scope of the new lines, with list dealt with in the Parliamentary Session of 1902. Map and report of the Committee proceedings. 4700 w. Elect'n, Lond—June 6, 1902. No. 48760 A.

We supply copies of these articles. See page 809.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* Boston.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Jl. of Science. *m.* New Haven, U.S.A.
American Machinist. *w.* New York.
Am. Manuf. and Iron World. *w.* Pittsburg, U. S. A.
American Shipbuilder. *w.* New York.
American Telephone Journal. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. d Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *qr.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Armee und Marine. *w.* Berlin.
Australian Mining Standard. *w.* Sydney.
Autocar. *w.* Coventry, England.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Brick Builder. *m.* Boston.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin American Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bulletin Scientifique. *m.* Liege.
Bull. Soc. Int. d Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Montreal.
Canadian Mining Review. *m.* Ottawa.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Contemporary Review. *m.* London.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Electrochemist & Metallurgist. *m.* London.

Elektrizität. *b-w.* Leipzig.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penn'a. *m.* Pittsburg, U. S. A.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland, U. S. A.
Gas Engineers' Mag. *m.* Birminghan.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e. d. Str. Ferr. *w.* Rome.
Glaser's Ann. f. Gewerbe & Bauwesen. *s-m.* Berlin.
Horseless Age. *w.* New York.
Ice and Refrigeration. *m.* New York.
Ill. Zeitschr. f. Klein u. Strassenbahnen. *s-m.* Berlin.
Indian and Eastern Engineer. *m.* Calcutta.
Ingeneria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron & Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. Am. Foundrymen's Assoc. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery. *b-m.* Fort Monroe, U.S.A.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallographist. *qr.* Boston.
Metal Worker. *w.* New York.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* City of Mexico.
Minerva. *w.* Rome.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. m. Vienna.
Modern Machinery. *m.* Chicago.
Monatsschr. d Wurtt. Ver. f Baukunde. *m.* Stuttgart.
Moniteur Industriel. *w.* Paris.
Mouvement Maritime. *w.* Brussels.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *m.* New York.
National Builder. *m.* Chicago.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
North American Review. *m.* New York.
Oest. Wochenschr. f. d. Oeff Baudienst. *w.* Vienna.
Oest. Zeitschr. f. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Power Quarterly. New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Progressive Age. *s-m.* New York.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Digest. *w.* New York.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Review of Reviews. *m.* London & New York.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. ed Agr. *b-m.* Catania.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Gen. des Sciences. *w.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Sanitary Plumber. *s-m.* New York.
Schiffbau. *s-m.* Berlin.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Stahl und Eisen. *s-m.* Düsseldorf.
Steam Engineering. *m.* New York.
Stevens' Institute Indicator. *qr.* Hoboken, U.S.A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Telephone Magazine. *m.* Chicago.
Telephony. *m.* Chicago.
Tijds. v h Kljk. Inst. v Ing. *qr.* Hague.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. of Civil Eng. *m.* New York.
Trans. Am. Soc. of Heat & Ven. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Western Electrician. *w.* Chicago.
Wiener Bauindustrie Zeitung. *w.* Vienna.
Yacht. *w.* Paris.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a. S.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post-Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Alternating-Current Apparatus.

Alternating Current Machines: Being the Second Volume of Dynamo Electric Machinery; Its Construction, Design and Operation. By Samuel Sheldon, A. M., Ph. D., and Hobart Mason, B. S., E. E. Size, 5 in. by 7½ in.; pp. IV, 259; figures, 184. Price, $2.50. New York: D. Van Nostrand Company. London: Crosby, Lockwood & Son.

This book, like its companion volume on direct-current machines, is primarily intended as a text-book for use in technical educational institutions. It will also be of use, however, to engineers who are not perfectly familiar with the subject of alternating currents, but whose work leads them into this field, and it is furthermore intended for those who are studying by themselves and who have acquired some proficiency in mathematics. The first four chapters contain a clear treatment of the theory of alternating currents. The next four are devoted to the construction, principle of operation and behavior of the various types of alternating current apparatus. Another chapter treats of power transmission, and the last gives directions for making a variety of tests on alternating current circuits and apparatus. The book is well illustrated and has an index, and is altogether a very good work, combining, in a happy degree, conciseness with comprehensiveness.

Balancing of Engines.

The Balancing of Engines. By W. E. Dalby, M. A., B. Sc. Size, 5½ in. by 8½ in.; pp. XI, 283; figures, 173. Price, 10s. 6d. New York: Longmans, Green and Co. London: Edward Arnold.

The main object of this book is to develop a semi-graphical method which may be consistently used to attack problems connected with the balancing of the inertia forces arising from the relative motion of the parts of an engine or machine. But the author, who has made other important contributions to the subject of engine balancing, does much more than this, and after a general treatment of the theory of balancing, discusses its special applications to locomotives and marine engines, and also takes up the question of the vibrations of the supports and, particularly, of the hulls of ships. Only very slight reference is made to D. W. Taylor, of the Construction Corps, U. S. Navy, who has done so much original work in this field, and the system which he was probably the first to describe is here called the "Yarrow-Schlick-Tweedy." Considered on the whole, however, the present work is a most timely and notable one on a subject which is assuming greater and greater importance, and it will undoubtedly prove very useful to the designer and engineer.

Cost-Keeping.

The Cost of Production. By Charles J. Watts. Size, 5 in. by 7¾ in.; pp. 64; figures, 21. Price, $1.00. Muskegon, Mich., and Chicago: The Shaw-Walker Company.

This is a neat, well-made, paper-covered book describing and illustrating a card cost system, which, while free from all the intricate problems of a balance-ledger system, furnishes information sufficiently accurate for all practical purposes. It will enable the progressive manufacturer to determine his own costs absolutely as well as to point out to his superintendent any weakness existing in the operation of the factory, and so provide for a speedy reduction of excessive expense in the cost of manufacture.

Heating and Ventilation.

Steam Heating and Ventilation. By William S. Monroe, M. E. Size, 5¾ in. by 9¼ in.; pp. 150; figures, 89. Price, $2.00. New York: The Engineering Record.

The chapters comprising this book were originally written as a series of articles for *The Engineering Record* and have been somewhat revised for their present form. It has been the aim of the author to present briefly the theoretical considerations involved in the design of heating and ventilating plants, and to compile the best of the large array of empirical formulæ and data in a way that will be of value to those interested in the current practice of the art. In this design he has succeeded remarkably well, and his work will be most useful to heating and ventilating engineers, as well as instructive to the general public which has such a vital concern in the matter.

Iron Industry.

Jahrbuch für das Eisenhüttenwesen. (Ergänzung zu "Stahl und Eisen.") Edited by Otto Vogel, for the "Verein deutscher Eisenhüttenleute." Size, 6 in. by 9½ in.; pp. XVI, 460; figures, 77. Price, 10 marks ($2.50). Düsseldorf: August Bagel.

This first volume of an "Annual for the Iron Industry," covering the year 1900, is issued to supplement the semi-monthly journal "Stahl und Eisen" and "Gemeinfassliche Darstellung des Eisenhüttenwesens," the publications of the "Verein deutscher Eisenhüttenleute," the leading German metallurgical society. This annual gives a systematic account of the progress in all branches of the iron and steel industry for the year, there being about 1,800 abstracts and references gathered from 110 journals printed in eight different languages. The divisions of the book conclude an historical introduction, fuels, ores, processes of manufacture, descriptions of works, properties of iron and steel, alloys, testing of materials, etc., and an index to authors, as well as a comprehensive general index add greatly to the convenience of a very serviceable and valuable work.

Mathematics.

On the Study and Difficulties of Mathematics. By Augustus De Morgan. Edited by Thomas J. McCormack. Size, 5 in. by 7½ in.; pp. 288; figures, 13. Price, $1.25 (4s. 6 l.) Chicago: The Open Court Publishing Company. London: Kegan Paul, Trench, Trübner & Co., Ltd.

This is the second reprint edition of the famous work in which the author illumines the mazes of mathematics with the light of common sense. The original treatise, published by the Society for the Diffusion of Useful Knowledge, in 1831, is now practically inaccessible, and is marred by many errata which have been corrected in the present edition.

Mechanics.

The Science of Mechanics: A Critical and Historical Account of its Development. Translated from the German of Prof. Ernst Mach by Thomas J. McCormack. Size, 5¼ in. by 7½ in.; pp. XIX, 587; cuts and illustrations, 259. Price, $2.00 (9s. 6d.) Chicago: The Open Court Publishing Company. London: Kegan Paul, Trench, Trübner & Co., Ltd.

This is the second edition of the translation, prepared from the fourth German edition of Prof. Mach's highly interesting and thought-compelling examination of the foundation of our scientific beliefs. The author's additions to his first edition, which are considerable, have been relegated to the appendix of the present translation. These additions are generally either supplementary in character or in answer to criticisms, but some are of special importance, as, for instance, the discussion of Hertz's *Mechanics* and the history of the development of Prof. Mach's own philosophical and scientific views. There is also a chronological table of a few of the most eminent scientific inquirers and their more important mechanical works.

Pavement.

City Roads and Pavements Suited to Cities of Moderate Size. By William Pierson Judson. Size, 5¾ in. by 8½ in.; pp. 195; illustrations. Price, $2.00. New York: Engineering News Publishing Company. London: E. & F. Spon; and Sampson Law, Marston & Co., Ltd.

This is an enlarged and revised edition of a work first published in 1894. In fact, there has been such an advance in methods of paving and roadmaking in the last eight years that the present book is practically a new one. It contains well-illustrated and up-to-date descriptions of the various kinds of pavement in practical use, with costs of laying and maintenance, and many statistics for cities and localities all over the United States, with occasional references to European experience. There are chapters on concrete base for pavement, block-stone pavement, wood pavement, vitrified brick pavement, asphalt pavement, bituminous-macadam pavement and broken-stone roads. One valuable feature is a description of simple and practical cement tests, which can be made by the city engineer himself, with an outfit costing not over four dollars and which can be stored in a desk pigeon-hole. The book is supplied with an index, and altogether, it can be heartily recommended to all who are interested in city pavements.

Water-Supply.

Water-Supply. (Considered Principally from a Sanitary Standpoint). By William P. Mason, Professor of Chemistry, Rensselaer Polytechnic Institute. Size, 5½ in. by 9 in.; pp. VII, 448; figures, 40, plates, 22. Price, $4.00. New York: John Wiley & Sons. London: Chapman & Hall, Limited.

This is the third edition of Professor Mason's standard work on water-supply, brought up to date and practically rewritten. The author is a doctor of medicine as well as a chemist, and is thus peculiarly qualified to treat his subject in the manner indicated in the sub-title. Special attention is given to the relations between drinking-water and disease, water pollution and water purification, but the whole subject of water supply is ably discussed and well illustrated. There are many tables of statistics, records of analyses and references to authorities, and the work is completed by a comprehensive index.

IMPROVED MACHINERY

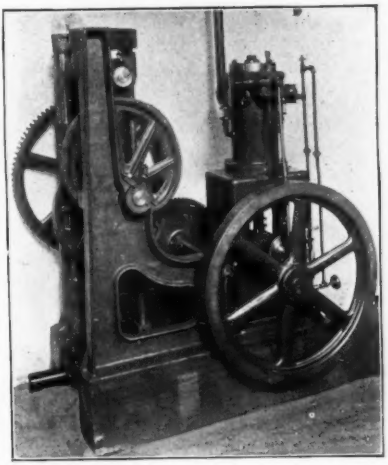
New Processes and New Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

The Luitwieler Pump.

THE Triumph Pump, invented by Mr. S. W. Luitwieler, is one which delivers water in a continuous stream, thus avoiding the loss of power due to the starting and stopping of a column of water as in the ordinary reciprocating pump.

Ever since the application of steam to pumping machinery, inventors have busied themselves with the difficult problem of producing a pump which would run by power and deliver a uniform stream of water. It is frequently desirable for commercial reasons to have the water come in an unbroken stream without pulsation, but the principal reason for making such a pump is found in the economical operation of the apparatus itself.



LUITWIELER PUMP.

In ordinary pumps operated by cranks, it is obvious that the water is delivered faster per inch of crank movement when the crank is midway between its dead centers than it is when passing these points, It is also obvious that both the plunger and the crank are virtually at rest for an appreciable interval of time when passing the dead centers. This stopping point occurring twice in every revolution is what causes the water hammer, or sudden stoppage of the column of water, thus requiring an extra amount of power to start the column in motion again.

A reference to the figure will show the construction of Mr. Luitwieler's device, which is designed to overcome the difficulty outlined above by a means at once simple and efficient. The piston acting in the pump chamber is connected with upright rods attached to yokes surrounding a cam, which hold rollers at each end. The rollers run upon these cams. The upper roller bears upon the outside surface of the cam and receives the thrust of the power. The lower roller bears upon the smaller or auxiliary cam, which is designed for the purpose of rapidly returning the pump piston to its lowest point without loss of time and without depending upon gravity for this purpose. There are two of these pistons working one above the other in the same cylinder, each provided with its separate set of cams and rollers. Owing to the peculiar shape of the cams, one piston has not finished delivering its volume of water before the second one comes into action. As before stated, this is accomplished by having the return of the piston to its starting point of pumping action made quicker than its motion when moving a column of water, which is accomplished by the cams of the peculiar shape shown.

In the illustration (the cams revolve from left to right) the nearer cam is at its uppermost limit while the cam furthest from the observer has already come into action and has lifted the water load at least half an inch. The load is now entirely on the fur-

ther cam, where it will continue until the topmost point is almost reached. By that time the nearer cam will have returned its piston to its lowest point where it will take up the load before the further cam is through with it. In this way the continuous motion is kept up and the water hammer is avoided. Both cams are upon the same shaft and balance each other, and so easily do they run that it is said a man can revolve all the parts at ordinary pumping speed with one hand. The application of power is extremely simple and consists of an elementary train of gears, and the pump can be operated by steam engine, electric motor or any other prime mover. The whole apparatus is extremely simple and compact, which is of immense advantage, for instance, in deep-well pumping, mine pumping, or railroad tank service or where the machinery must be moved from place to place.

This working head also operates outside a packed plunger pump.

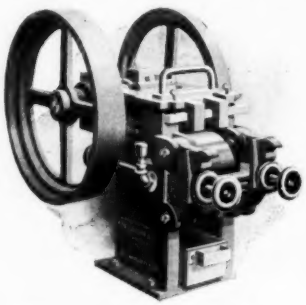
Any further information desired concerning this interesting pumping machinery will be gladly furnished by the manufacturers, The S. W. Luitwieler Company, of Los Angeles, California.

Perfection Ore Crusher.

The Perfection Ore Crusher and Pulverizer has recently been placed on the market for assayers' use. It is arranged for pulverizing samples of ore and other materials from 2 inches in diameter to 60 mesh or finer powder. In reality it is a combination roll and jaw crusher; the portion called the stationary jaw in other crushers being replaced in this by an upper removable jaw and steel pulverizing roll. This permits heavy crushing to be done against the upper portion, while the pulverizing is accomplished between the roll and the lower part of the vibratory jaw that is ground to conform to the contour of the roll. The crushing is accomplished by a motion of the vibratory jaw imparted by the eccentric on the shaft. The heel of the vibratory jaw is stationary, and this causes the lower portion, which is opposite the roll, to vibrate through an arc of a circle, insuring a discharge of the crushed material.

The back motion on the steel roll is prevented by three small rolls or chokes. The adjustment is simple and effective, and is by means of two pairs of set screws which press on the opposite sides of the boxes in which the roll is journalled. When once adjusted all further motion is prevented by tightening the two thumb screws.

The arrangement for cleaning is excellent. By pulling out a wedge and dropping two latches, the upper stationary jaw and the roll may be quickly removed. As the jaw and cheek plates are accurately fitted to each other, fine pulverizing may be accomplished, although it is necessary to run the material through the machine several times if very fine product is desired. The hardness of the ore and the fineness of the product obtained necessarily determine the capacity, which will vary from 40 to 75 pounds per hour. Several tests through a



PERFECTION ORE CRUSHER.

six-pound sample of ore of varied hardness showed that three pounds of the product passed a 60 mesh screen at the first feeding, and the balance a 10 mesh. By adjusting and re-feeding, 4½ pounds passed a 60 mesh, and 2 pounds of this quantity, 100 mesh, the balance going through a 30 mesh. To reduce the entire 6 pounds to a 60 mesh or finer, it was necessary to refeed the material twice again.

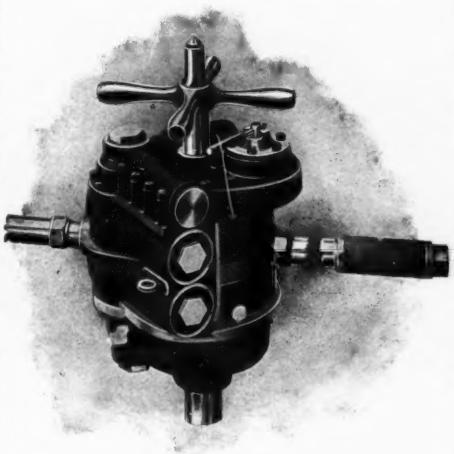
These tests were made with a power machine, operated by ¼ horse-power motor speeded to 200 revolutions per minute.

The manufacturers, Messrs. F. W. Braun & Co., Los Angeles, Cal., expect that this crusher will be one of the most satisfactory on the market for an assay laboratory. They have had quite an extended sale of a machine similar to this during past years, and will be pleased to furnish any further information desired.

Reversible Pneumatic Drill.

We illustrate herewith a new reversible drill of the "Little Giant" type, recently developed and put on the market by the Chicago Pneumatic Tool Company. This machine was primarily designed to meet the want of customers who require a drill for general use, but whose work is not sufficiently specialized to warrant the purchase of any one of the "Little Giant" exclusive reaming and tapping machines.

The motor is of the same general construction as all of the now well-known and time-tried "Little Giant" drills, the distinguishing features of which are four single-acting pistons coupled to one crank shaft at angles of 90°, each piston of each pair traveling in opposite directions at all times insuring a well-balanced and durable engine. All moving parts are in an oil tight case, and each pair of cylinders is controlled by one balanced piston slide valve. These features are fully covered by United States and foreign patents, and are found in no other pneumatic drill. To these has been added a simple reverse valve of the same construction as in the Nos. 11 and 12 machines, but so situated that it does not interfere with the feed screw when the machine is used as a simple drilling machine.



REVERSIBLE PNEUMATIC DRILL.

The controlling lever may be removed from the motor when it is not required as a reversible machine. It can then be controlled with the ordinary throttle, which is situated at the side of the machine, as in the plain drills.

The reverse valve can be used as a throttle valve, however, when very rapid and accurate reverse motion is required, as would be the case when the motor was used in connection with the machine for setting locomotive slide valves, or when tapping to a given point or to bottom, and in various other applications which will readily suggest themselves to the mechanic requiring a machine of this kind.

These motors are made in three sizes, and like parts of these drills are interchangeable with those of the plain drill of the same size, which will be appreciated by the trade, as it avoids complication of parts.

Some of the improvements that will commend themselves to mechanics who have used these drills are as follows: All bearings are furnished with removable bushings; the crank journals have been increased by 50 per cent.; the crank pinion is now shrouded on both ends (formerly on one end only) which will prevent teeth from breaking; the upper and lower bearings for the crank shaft are bronze; sleeves of ball and socket form easily removed, no screws being required to hold them in place, which form of bearing insures perfect alignment always and consequent increase in speed and power; hardened steel eccentric straps connect valves to crank shaft in place of the bronze used formerly; oil plugs have been dispensed with; oil is poured in through the handle, and as it is impossible to use the drill without this handle, and nothing else will fit the hole, the handle will surely be replaced even by the most careless workman, and this insures long life to the working parts: a leather packed stuffing box is supplied to keep the oil from escaping; every moving part is hardened and ground to fit.

Any further information concerning these drills will be cheerfully given by the Chicago Pneumatic Tool Company, of Chicago, which also manufactures air compressors, cranes, hoists and pneumatic tools for all purposes.

Ring Packing.

THE Geo. W. Knowlton Rubber Company have had an experience of twenty years in the manufacture, sale and actual use of belts, hose, packings for all kinds of work, valves and rubber specialties for various purposes, and are therefore specially fitted to be of practical assistance to their customers in determining what is best for any given purpose, and to specify at once the process of manufacture as well as the compound to be used to secure the desired service.

Their regular "G. W. K. Ring Packing," for steam, water or ammonia, which is illustrated herewith, has met with the approval of every engineer who has tried it, as it meets the requirements so perfectly without trouble to him. It cannot blow out in ribbons, because no ribbons are there to be blown out. Being a "two-part" packing, there are no joints in the middle to give way. There are just the wearing part and a good rubber cushion in the only correct position to give the proper expansion; not enough to cause trouble and require constant attention, but just enough to "make tight" with the least possible friction, and give a gradual expansion to take up the wear and keep tight until worn out.

Complete information regarding these packings and all their other specialties will be gladly furnished by the Geo. W. Knowlton Rubber Company, 72 Broad Street, Boston, Mass.

G. W. K. RING PACKING.

Steam Meter.

IN systems for the distribution of steam for power, heating and all other purposes from central stations, both those designed especially for supplying outside customers, as well as the plants which use only their surplus product in this way, it is of the greatest importance to have a reliable means for measuring the amount of steam supplied to each consumer.

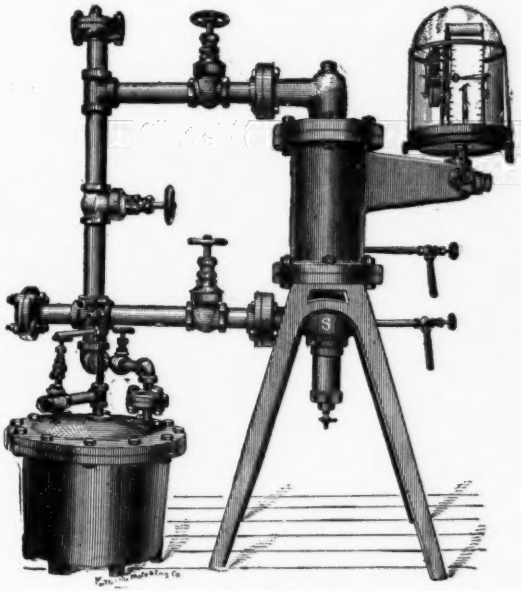
Such an instrument is the steam meter, illustrated herewith, which is patented by Mr. G. C. St. John and in use by the New York Steam Company. In this meter, a tapering valve, with its guide rods and piston head standing perpendicularly in casings and dashpot, rises and falls, and so in-

creases or diminishes the annular space between itself and its seat, in accordance with the flow of steam through the aperture. The motion of the valve is communicated through a lever to a pencil, which makes a record on a moving strip of paper.

This meter being based on the fact that the flow of steam through an orifice at a constant pressure is proportional to the area of the orifice, it will be seen that it is essential to keep the pressure on the inlet side of the meter as nearly uniform as possible and the inlet valve wide open. When steam is passing through the meter the movable pencil is recording the opening or lift of the valve of the meter. At the same time, clockwork is moving the paper at the rate of a half inch per hour. These combined motions, one in a horizontal, and one in a vertical direction, result in an irregular rectangular diagram. The mean height of the diagram is obtained by means of a planimeter, as in the case of an indicator card. The mean height thus obtained is multiplied by a constant, the constant in each case being so many pounds of steam per hour for one inch in height at a pressure of a certain number of pounds, other heights being in direct proportion.

The number of hours steam has passed through the meter is readily obtained by multiplying the length of the diagram in inches by two. This figure multiplied by the rate per hour will give the total amount of steam for a given time.

Any further information on this matter will be gladly furnished by Mr. G. C. St. John, of 143 Liberty street, New York City.



ST. JOHN STEAM METER.

Treatment of Steel Tools.

In the course of excavating for the New York Subway, the Degnon-McLean Co., contractors for a section of this tunnel, struck rock of such hardness, that something had to be done to harden the rock drills, which wore away unusually fast. The use of a new compound called "carbomangan" was resorted to, and proved an enormous help. This compound is employed in a manner similar to oil in hardening. It does not temper the steel, but may properly be said to refine or contract it, bringing the molecules into the closest pos-

sible relation, and thus making even inferior grades of tool steel exceedingly tough and fine grain. The chisel, drill or tap is brought to a cherry heat and immersed in a bath of "carbo-mangan," then cleaned, reheated and tempered as usual. The effect of this treatment is very easily observed, especially in tools of large diameter, say three or four inches round, where the calipers will show a small shrinkage. This alone tends to show the action of "carbo-mangan" in affecting the steel not alone on the surface, but throughout. By actual trial for months, "carbo-mangan" treated dies have shown an average gain in durability of about 25 per cent. over the dies not so treated. This test was made on nipple cutting machines in the shops of the John Simmons Company, of 110 Centre street, New York. These machines are of the double-head type, thus affording the best imaginable opportunity for a comparison of die qualities under absolutely equal conditions, but numerous other experiments on cast steel have shown plainly what this compound does for steel. One average result on test bars about 0.8 inch in diameter, subjected to a tensile strain, showed that by treating with "carbo-mangan" the elastic limit was increased from 13,550 to 26,200 pounds, and the ultimate strength from 36,000 to 42,000 pounds. This was the ordinary cast steel made by the American Steel Casting Company of Thurlow, Pa.

The average cost of treating steel with "carbo-mangan" is about ½ mill per pound of metal, and the compound is good till used. It does not deteriorate with use, and the evaporation is but slight. Thirty pounds of "carbo-mangan" will last a large shop several months, and the compound is put up in 10-gallon tins for trial.

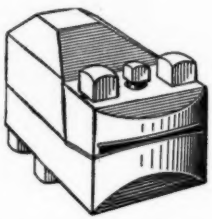
Write to John Simmons Company, 110 Centre street, New York, for description, pamphlet, prices and numerous testimonials by shops of world-wide reputation.

Oil Burner.

THE recent discoveries of petroleum in Texas, California and other parts of the world have given a tremendous impetus to the use of oil for fuel purposes, and in the practical application of liquid fuel, the burner is of the first importance.

Mr. C. A. Hammel, of Los Angeles, is the pioneer in the oil-burner business in California. For fourteen years he has devoted his attention exclusively to the manufacture of these burners, his one idea in all his work having been to come as close to perfection as possible. Some years ago his burner seemed the best on the market, but with the eye of a clever and careful mechanic he detected faults still, and only three months ago did he arrive close enough to perfection to suit him. The principle of the new burner is simple, being merely the atomizing of oil under high steam pressure, and its introduction to the furnace in such a manner that it will most effectually touch with its heat all available points where steam might be generated. In nearly all burners there is an unheated, gaseous space just ahead of the oil-nozzle, before the ignition of the fluid. After long experimenting Mr. Hammel has succeeded in producing immediate ignition, yet far enough beyond the nozzle to prevent unnecessary wear on that part.

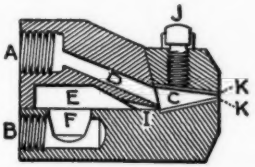
The accompanying illustrations show a perspective view and a longitudinal section: A is a threaded orifice in the rear end of the burner, into which the oil-supply pipe is screwed. B is a like orifice, into which the steam-supply pipe is screwed. C is a chamber communicating with the orifices A and B and in which the oil and steam are commingled before being injected into the combustion chamber. The rear wall of chamber C is much narrower and deeper than the mouth thereof, and the top and bottom incline toward each other and broaden out laterally at the mouth.



HAMMEL OIL BURNER, PERSPECTIVE VIEW.

The face of the burner being curved, as shown, and the top and bottom of the mixing chamber being flat and converging to the

mouth and the center projecting beyond the sides, the mouth will be contracted or narrowed in the center and wider out toward the sides, giving to it the form shown. This form of construction has been found in practice to be particularly desirable, as the flow of the steam and oil would be greatest at the center if the opening at the mouth were uniform; but by gradually contracting the opening as the center of the mouth is approached the flow of oil and steam through



HAMMEL OIL BURNER, LONGITUDINAL SECTION.

the mouth is equalized and a broad, even flame produced.

E is the steam-expansion chamber and is connected with the steam-supply pipe by the duct F. It is also connected with the mixing chamber C by three ducts, which cause the jets of steam to impinge upon each other, thereby breaking up the oil flowing between them into minute atoms or particles. It will also be observed that the bottom of chamber C inclines upward and the top downward to the mouth thereof, and the steam and oil as they enter therein strike on the bottom and are deflected to the top, then back to the bottom, and so on back and forth until they pass out of the chamber. This impact is very beneficial, as it aids in atomizing the oil and in properly mixing it with the steam before its exit from the chamber.

It is understood that regulating valves are provided in the supply-pipe leading to the oil-reservoir and steam-supply, respectively, whereby the admitted amount of oil and steam may be regulated.

This burner will not carbonize or clog, as the steam passing through keeps it always clean, and it is adapted for use with crude oils of any grade and specific gravity. The burner is now being successfully applied to locomotives, and it can also be used with compressed air or steam for atomizers.

Messrs. Chas. Moore & Co., of San Francisco, the Pacific Coast agents of the Babcock & Wilcox Boiler Co., made a test of this burner for their own special benefit, and found that in a four days' run of a plant, the evaporation was 14.7 pounds of water per pound of oil, with feed water at and from 212°F.

All the largest and most modern plants in Los Angeles have adopted this burner, and Mr. Hammel will be pleased to furnish any further information which may be desired.

Ore Concentrator.

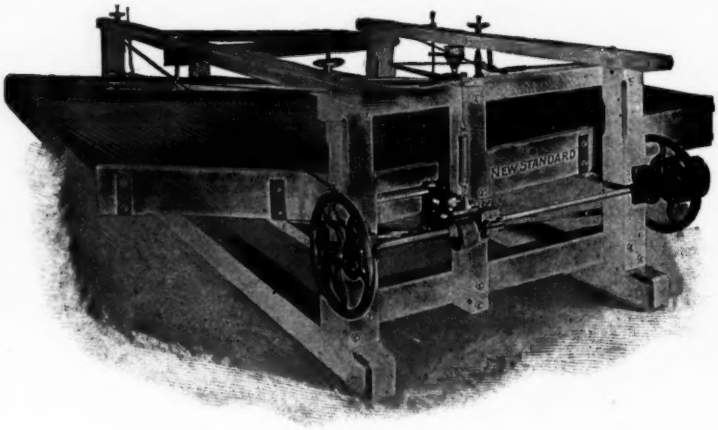
THERE is, perhaps, no more important subject for discussion in the entire range of the mining industry than that which treats of the methods employed in the concentration of the values found in ores; and its importance becomes paramount when we are reminded of the fact that the miner's chances for success or failure in the majority of instances, depend entirely upon the methods he selects to accomplish this separation and concentration.

All of the baser minerals have a higher specific gravity than the rock which carries them, and in order to save them, it is necessary to have a machine which can be so adjusted that the least variation in the specific gravity of the materials will cause the particles to separate from each other and the heavier particles to be cleaned from the lighter ones.

The New Standard Concentrator is especially designed to separate any material of greater specific gravity from the lighter gangue which contains it. This machine is of the bump type—a form well known and used for years in the concentration of ores. It is so arranged that the bump can be regulated from the lightest percussion to a heavy blow. The percussion of the table, together with its swing, causes the ore to travel toward the percussion side of the table; the table meanwhile being inclined at a suitable angle to allow the wash-water to carry the lighter particles from the top of the ore backward at an angle to the line of bump of the table. This acts so as to carry the heavier particles of the ore to the farthest limit. where they are met and overcome by the current of the wash-water, which is at right angle to the travel of the light gangue.

An important matter in the concentration of ores is to first accomplish a thorough settling; to precipitate the heavy particles to the bottom, thus leaving the lighter particles on the top. Another important feature is to protect the heavier particles which have settled to the bottom, and allow their uninterrupted travel to the final cleaning space. These objects are attained by the New Standard Concentrator by providing riffles on the table surface, which permits the settling of the heavier particles, and also protects them from the sluicing action of the water, while the motion imparted to the table, combined with the bump, moves the mineral across the table to the final cleaning space. The riffles are arranged at a line tangent to the line of the bump of the table, which causes the water to wash squarely over them. The travel of the mineral or heavier particles being in the line of the bump and the riffles being tangent to this line, cause the mineral to travel along the riffles on their under-sides. To prevent the concentrates from having to travel the entire distance of the riffled surface of the table at a line tangent to the bump, the riffles of the New Standard Concentrator are made of a length not to exceed 18 inches, and are pointed or beveled at their ends, and are set with openings between their ends approximately on the line of the bump; this causes the mineral to pass upward and through the riffle lines, and strike the riffle next above. While the mineral is passing between the ends of the riffles, it is protected from any sluicing action of the water by the riffle next above it.

The table is suspended from the superstructure of the machine by means of hooks, and is counterbalanced between a pull-string and a cushion spring. Motion is imparted to the table by means of a pull-rod attached to the bottom of the table through the means of a bell-crank, which is actuated by an irregular, heart-shaped cam. The lines of the cam are so drawn that the motion of the table is accelerated and arrested by it, giving to the table the proper travel and speed required at its different positions. This arrangement of the mechanism allows the table to be swung free from all operating means, and when the cam is at rest the table can be freely swung by the hand; the cam, with its different lines, simply times and gives the proper speed to the table.



NEW STANDARD ORE CONCENTRATOR.

The table, being hung from the superstructure, can be raised or lowered to give it any inclination desired, as there are three points of support. The narrow portion, or upper end of the table, is carried by a yoke, which has a central support passing up through the superstructure, and a hand-wheel to raise and lower the same. The lower corners of the table are supported in like manner. The pull-rod is attached to

the bottom of the table by means of a hinge joint and passes through a roller-joint in the bell-crank and has a block and cushion-washer to ease the motion of the bell-crank.

The New Standard Concentrator, being narrower at the head than at the foot, brings the ore under the action of the wash-water as soon as it commences to travel down the table, and keep the heavy particles up to the line of action of the wash-water until the ore is thoroughly cleaned from the gangue. It may be said that the ore is washed and cleaned for a distance of 14 feet. This fact alone guarantees thorough and clean work. The arrangement of the riffles allows of the ready discharge of the ore to the wash-water side, and at the same time protects the fine mineral from being again mixed with the gangue and washed away.

The New Standard Concentrator has a greater range of adjustment than any concentrator heretofore offered to the mining world, and through this great range of adjustment is adaptable for almost any kind of ore. It is the invention of Mr. Luther Look of Los Angeles, California. Mr. Look is a man of thorough mechanical skill, and after having given many years to the study of mining, and especially to the concentration of ores, he has now devoted the best energies of his life to the perfecting of a machine wherein the knowledge he has gained may be turned to use. As the result of his untiring efforts, the New Standard Concentrator Co. is now able to offer to the mining public a machine of superior capacity, marvellous in its simplicity, perfect in its movement, unequaled in the method and range of its adjustment, and unrivalled in the quality and cleanness of its work.

The claims made for this new machine are not theories evolved from laboratory tests, but from the results obtained by thorough competitive trials made against the best and leading machines hitherto found in the market, and the general agents, Messrs. P. B. McCabe & Co., of Los Angeles, California, will be pleased to give any further information desired.

Industrial Notes.

—The Electric Storage Battery Company of Philadelphia announces that Mr. G. F. Greenwood, 34 Empedrado Street, Havana, Cuba has been appointed agent for the sale of the "Chloride Accumulator" in Cuba. All inquiries and business from this section should be forwarded to Mr. Greenwood and will receive from him prompt attention.

—The Cleveland Pneumatic Tool Company, Cleveland, Ohio, have purchased a tract of land on Hawthorne and Second Avenues, and will at once begin the erection of modern factory buildings. They have outgrown their present shop space, and are unable to keep up with their orders. They will employ about 150 men in their new plant, and hope upon its completion to be in a position to serve the trade more promptly than at present. Electrical power will be used in driving the machinery.

—The Ball-Bearing Company (of Maine), of which Mr. W. S. Rogers is president and general manager, is about to engage actively in the manufacture of anti-friction ball and roller bearings of the highest grade, at their works situated in Keene, N. H.

—The San Gabriel Electric Company, of Los Angeles, Cal., has recently purchased a 750 K. W., two-phase, engine-type Westinghouse generator which is to be installed in a sub-station of the Pacific Light & Power Company. The latter company has recently acquired the San Gabriel Company and the new alternator will be used in connection with its general system of lighting and power in Los Angeles and the vicinity.

—The Westinghouse Electric & Mfg. Co. has recently issued a very interesting and attractive circular describing "Electric Motor-Vehicle Equipments." This company has for five years supplied motors to the electrical vehicle industry and now offers a complete line of standard automobile equipments comprising everything of an electrical nature, except storage batteries, pertaining to the motive power of an electric vehicle of any type or size. This circular will be sent upon request.

—The Lake Shore Engine Works, of Marquette, Mich., have been advised by the secretary of the South Carolina Inter-State and West Indian Exposition, that they have received a certificate of award, and gold medal for the "Superior" marine gasoline engine. This award was given for simplicity of construction, sureness of action, perfection of build, large horse power de-

veloped in small space, and minimum weight; and in addition the manufacturers have received a very complimentary testimonial from the Board of Award, speaking of the general excellence and merits of the engine.

—The engineering department of the Pittsburgh Gage & Supply Co., Pittsburgh, Pa., has secured through Victor Boutner, engineer, Westinghouse Building, Pittsburgh, an order for one pair of 600 H. P. Brown Corliss Engine Co. (Corliss, Wis.) twin engines to drive direct-connected electric generators at 136 revolutions per minute in the new mill of the Susquehanna Iron & Steel Co., Lancaster, Pa. They have also secured orders for one complete White Star Filtering System for the new plant of the West Moreland Light & Power Co., Greensburg, Pa., of which James Bryan, Park Building, Pittsburgh, is the electrical engineer. Another notable order was from the Hoover, Owens & Rentschler Co., Hamilton, O., for supplying two cross-compound engines of their manufacture with a White Star Filtering System. These engines are destined for the power plant of the Cincinnati, Georgetown & Portsmouth Railway Co.

—The American Ferrofix Company, of 29 Broad Street, New York, has given an option on its property to a syndicate which proposes to greatly enlarge the sphere of usefulness of Ferrofix by appointing agents in every township in the country. These agents are to be educated in the use of Ferrofix so that not only cast iron and steel may be perfectly brazed, but also that all metals shall be mended in this way in preference to welding, the result being much more satisfactory in every way, as well as costing less to do. The actual details of the new organization have not yet been perfected, but we are promised some interesting particulars for our next issue.

—The Standard Roller Bearing Company of Philadelphia, Pa., having found their present facilities inadequate to meet the growing demand for their product, have purchased a large and extremely valuable piece of trackage property near the center of the city, about ten minutes' ride from the City Hall, on the main line of the Pennsylvania Railroad, where they will build a very large factory for the manufacture of their well known roller bearings. It will be observed that the new plant is advantageously situated and it is intended to be a model one in every respect. It will be 200 feet long and from 100 to 150 feet wide. The principal buildings will consist of two factories 200 feet long and 60 feet wide, of improved design and construction, in addition to office buildings, etc., to be equipped with every convenience for the rapid and economical handling of the business. Work has already been started, and it is the intention of the Standard Roller Bearing Co., to eventually build still further, covering the entire property of about 2½ acres within a short time. The Ball Bearing Co., also of Philadelphia, recently removed from Boston, will occupy a portion of the new plant, which will be specially arranged to meet its needs. The rapid growth of the Standard Roller Bearing Co. is worthy of notice, as it is unusual for a business of this kind to develop so extensively within so short a time. Credit is no doubt due to the superior merit of the Company's product, which includes ball, roller and all kinds of anti-friction bearings of the highest grade, for machine construction.

—The Industrial Works, of Bay City, Mich., one of the largest manufacturers of railroad wrecking cranes in the world, will shortly install a large amount of additional electrical apparatus for the operation of its shops. A recent purchase from the Westinghouse Electric & Mfg. Co. includes a 150 K. W., direct-current generator, which will be used to furnish current to eighteen or twenty direct-current motors already in use in the plant, a 200 K. W., two-phase alternator, and a number of induction motors. The alternating current apparatus will be used entirely for power distribution. In addition to wrecking cranes the Industrial Works also manufactures smaller cranes and transfer tables.

—Hydraulic mining having been prohibited by the National Government in many parts of California, the hydraulic development companies are very profitably turning their attention to power and irrigation projects. The Central California Electric Co. has recently purchased two 1,000 K. W. Westinghouse alternating-current generators, which will be direct connected to water-wheels and used to supply power to

Grass Valley, Nevada City, Sacramento and adjacent towns. This is the third station to be installed by the company, two other stations having now been in operation for a number of years. The Central California Electric Company's system is a part of that of the South Yuba Water Co., which controls 400 miles of main ditch line in the heart of the Sierra Nevada Mountains. Formerly the water was used for hydraulic mining, but this having been stopped on account of the filling up of the rivers with "slickens," the water now is sold to ranchers and fruit growers for irrigation purposes. Before being sold to the farmers, however, it is transmitted in pipes to stations at different points along the system where electric energy is produced and conducted 35 to 50 miles to adjacent cities.

—A steam railway 40 miles long, the Cincinnati, Georgetown & Portsmouth Ry., is shortly to be converted from steam to electric traction. The Tennis Railway Equipment Co., who has the contract, has recently purchased from the Westinghouse Electric & Mfg. Co. two 600 K. W. A. C. generators and a number of 300 K. W. rotary converters for supplying current to the line.

—The Fayette Manufacturing Co. will use electrical power transmission for driving its new plant for the manufacture of refractory brick at Chester, Pa. The entire power for the mixing and grinding of the ingredients and for conveying the same to and from the various machines and finally pressing them into shape will be furnished by induction motors. The Fayette Company has recently purchased from Westinghouse Electric & Mfg. Co. a 3-phase equipment, including an engine-type alternator, exciter, switchboard, and alternating-current motors aggregating 290 H. P.

—The Continental Iron Works, of Brooklyn, N. Y., the builders of the famous "Monitor," have recently purchased from the Westinghouse Electric & Mfg. Co. considerable additions to their electrical equipment. The purchase includes a 180 K. W., 220 volt, 60 cycle, two-phase alternator, a five-panel switchboard, eleven induction motors of from 5 to 20 H. P. each, with the accompanying auto-starters. The company some time ago installed alternators of 120 K. W. and 45 K. W. each, and of the same characteristics as the above. They also have quite a number of induction motors in use driving corrugating and bending rolls for making Morrison fire-boxes, also driving fans, shears, tools in the machine shop, etc. Some of the motors which have recently been purchased are to displace direct-current motors, the original installation at this particular plant having been of direct-current apparatus. Afterwards a 45 K. W. alternator was put in to try alternating current distribution and subsequently the 120 K. W. and 180 K. W. alternators have been purchased. The direct-current motors are rapidly being replaced by alternating-current induction motors, and this is after a thorough and careful investigation of the subject and several years' trial of the induction motors. In fact, when the new 180 K. W. alternator is installed, the old direct current generator will be used as an exciter, also furnishing current to one or two small direct-current motors which will be used for a while until they are worn out.

—Pawling & Harnischfeger, Milwaukee, Wis., state that the demand for electric cranes and hoists remains highly satisfactory. The present booking of orders is on the average of one crane per day, which fully equals their works capacity. There is a noticeable broadening of inquiries, particularly from the Central and Western States, and the prospect for sales in these sections looks very good. The foreign demand is bettering, judging by the inquiries within the last month. Prominent among the recent purchasers of cranes and hoists are the following: Pennsylvania Railroad Co., West Philadelphia, one 6-ton trolley; Grand Crossing Tack Co., Chicago, one 75-ton ladle crane with 25-ton auxiliary trolley; Stanley Electric Mfg. Co., Pittsfield, Mass., for Michigan Lake Superior Power Co., Sault Ste. Marie, Mich., two 15-ton cranes; S. Morgan Smith Co., York, Pa., one 10-ton crane; Pressed Steel Car Co., Allegheny, Pa., one 5-ton special hoist; The Westinghouse Machine Co., East Pittsburg, one 10-ton crane; Pittsburg Plate Glass Co., Ford City, Pa., one 3-ton crane; Bethlehem Steel Co., So. Bethlehem, Pa., one 30-ton crane with 10-ton auxiliary trolley and 3 2-ton chain block cranes; The A. & F. Brown Co., Elizabethport, N. J., one 15-ton crane with 3½-ton

auxiliary hoist; Jas. B. Clow & Sons, Newcomerstown, O., one 5-ton hoist; American Foundry & Construction Co., Hazlewood, Pa., one 5-ton special hoist; Buffalo Foundry Co., Buffalo, N. Y., two 30-ton cranes with 5-ton auxiliary hoist and four 10-ton cranes; Ball Engine Co., Erie, Pa., one 25-ton crane with 5-ton auxiliary hoist.

Personal.

—Mr. Spencer Miller, engineer of the Cableway Department of the Lidgerwood Manufacturing Company, New York City, sailed for Europe on June 17th, on the "Patricia," to confer with naval officials regarding the equipment of several battleships with the Marine Cableway for coaling ships at sea. Mr. Miller will visit London, Paris, Berlin, St. Petersburg, and possibly other capitals before his return.

—Mr. W. M. Jenkins, General Manager of the Garlick's Cycle Supply Company, of Cape Town, South Africa, who has made an extended tour of the United States, is about leaving for home. While in this country, Mr. Jenkins made arrangements to represent many American manufacturers of electrical machinery and motor vehicles at Cape Town.

—Mr. G. P. Altenberg, foreign manager of the J. A. Fay & Egan Co., of No. 212 to 232 W. Front Street, Cincinnati, Ohio, the large makers of wood-working machinery, has just left on his annual trip to Europe, where he will visit the principal countries in the interest of his firm. He will also go to South Africa, where he will organize agencies and appoint representatives. The termination of hostilities there has opened up a fine market for the products of this company, and they are with their usual activity losing no time in taking advantage of this opportunity to introduce their wood working machinery. The address of Mr. Altenberg while in Europe will be No. 51 Wharton Road, Kensington, London, W., England, where he will be pleased to furnish any information desired concerning his line of machinery.

—Mr. James Rowland Bibbins has resigned as Assistant Electrical Engineer of the Detroit United Railway to accept a position in the Westinghouse Companies' Publishing Department, Pittsburg and New York.

—Mr. Samuel M. Nicholson has been elected president of the American Screw Company by its Board of Directors. Mr. Nicholson is already President and General Manager of the Nicholson File Company, the largest file and rasp concern in the world, which controls six large plants with home offices at Providence, R. I.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

A neat, illustrated catalogue of air compressors, carbonic-acid-gas pumps, vacuum and tar pumps, air-lift pumping system, air hoists, air receivers, compressed-air tools and appliances of every description. American Air Compressor Works, 26 Cortlandt St., New York.

Boilers.

A large handsome pamphlet (sixth edition) with well-illustrated descriptions of Fitzgibbons marine boilers designed for stationary steam plants. Also, another pamphlet with account of tests and recent installations of these boilers, and circulars showing the boilers equipped with furnace for burning refuse and low-grade coals and with Brightman mechanical stokers. Fitzgibbons Boiler Company, Oswego, N. Y.

Book-Cases.

Catalogue No. 102, with handsomely illustrated descriptions and price list of the Globe-Wernicke system of "elastic" book-cases, in units arranged in various combinations. The Globe-Wernicke Company, Cincinnati, New York, Chicago, Boston and London.

Book-Typewriter.

A very handsomely illustrated pamphlet (second edition) devoted to the Fisher Billing-Machine and Book-Typewriter for billing, tabulating, book recording, card systems and letter writing. The Fisher Book-Typewriter Company, Cleveland, Ohio.

Car Trucks.

Handsomely illustrated pamphlet, with descriptions of car truck, swing truck, truck end casting, truck bolster and body bolster. The Commonwealth Steel Company, St. Louis, Mo.

Cranes.

Handsome catalogue, No. 15, with well-illustrated description of electric traveling cranes, pneumatic cranes, hand power cranes and various other types of standard cranes. Northern Engineering Works, Detroit, Mich.

Crushers and Pulverizers.

A folder giving a long list of users of the Williams Patent Hinged Hammer Crushers and Pulverizers, manufactured by The Williams Patent Crusher and Pulverizer Company, St. Louis, Mo.

Drills.

A neat folder and a calendar devoted to radial drills. The American Tool Works Company, Cincinnati, Ohio.

Dynamos.

Bulletin No. 1024, with well-illustrated descriptions of direct-connected, direct-current generators. Also calendar. Fort Wayne Electric Works, Fort Wayne, Ind.

Electric Driving.

Bulletin No. 24, in a unique and tasteful cover, with handsome illustrations of motor-driven tools and other applications of the electric motor in the distribution of power. Crocker-Wheeler Company, Ampere, N. J.

Electric Switch.

Bulletins Nos. 10, 11 and 19, devoted to the Whittingham mechanically-operated reversing switch for electric motors, with dynamic brake and brake resistance, and to the Whittingham reversible motor-driven automatic motor starter. Automatic Switch Company, 131 Liberty St., New York.

Electric Transmission.

A reprint of a paper by Dr. F. A. C. Perrine, read before the New York Electrical Society, giving a very well illustrated description of electric power plants of the Pacific Coast, with remarkably long transmission lines, installed by the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

Emery Wheels.

Catalogue and price list of emery and corundum wheels, and illustrated descriptions of Reisch's foot-power emery wheel machines and other grinding machinery. Buffalo Emery Wheel Company, Buffalo, N. Y.

Engines and Boilers.

A well illustrated catalogue with descriptions of horizontal and vertical steam engines, tubular boilers, boiler feeders and auxiliary machinery. Larzelere Machine Company, Williamsport, Pa.

Engine-Stop.

A very handsome pamphlet containing a well illustrated description of the "Monarch System" of automatic safety devices for use on steam and electric motors. Consolidated Engine-Stop Company, 100 Broadway, New York.

Gasoline Engines.

Catalogue No. 3, with beautifully illustrated descriptions of the "Superior" marine gasoline engines and of various launches and other boats equipped with them. The Lake Shore Engine Works, Marquette, Mich.

A neat booklet, with well illustrated descriptions of four-cycle, 1¼ and 4 horse power gasoline and gas engines and their accessories, for stationary and portable use. Hardy Motor Works, Port Huron, Mich.

Gold Dredging.

A pamphlet with illustrated descriptions of Bewsher sand pumps, gold-dredging machinery and general dredging apparatus. General Construction Company, Seattle, Wash.

Graphite.

Mailing card, with account of the use of Acheson Graphite for the protection of the cables of the New East River Bridge, New York. International Acheson Graphite Company, Niagara Falls, N. Y.

Grinding Machine.

A circular, with illustrated description of a universal grinder and attachments. Greenfield Machine Company, Greenfield, Mass.

Heating System.

A neat pamphlet with well illustrated account of the Jas. A. Trane Gravity Vacuum System of Steam Heating, with a description of special features, particularly the mercury seal. The Jas. A. Trane Vacuum Heating Company, 40 Dearborn St., Chicago.

Lathe.

Tastefully illustrated pamphlet describing a new ten-inch by five-foot toolmakers' engine lathe, with its appliances. Pratt & Whitney Company, Hartford, Conn.

Machine Tools.

Three pamphlets, devoted respectively to grinding machines, drills and tapping machines. The St. Louis Machine Tool Company, St. Louis, Mo.

Mechanical Stoker.

Folder giving a list of recent purchasers of the Jones Under-Feed Stoker. The Under-Feed Stoker Company of America, Marquette Building, Chicago.

Milling Machines.

A tasteful pamphlet, with well illustrated descriptions of universal milling machines and their distinctive features. Brown & Sharpe Manufacturing Company, Providence, R. I.

Mining Machinery.

A series of well-illustrated bulletins, Nos. 1003, 1004, 1005, 1006, 1007, and 1008, devoted respectively to electric hoists, the Improved Cammett Concentrator, sample grinder, mine-timber framing machine, standard crushing and re-crushing rolls. The Denver Engineering Works Company (Shephard & Searing), Denver, Colo.

Packing.

Neat booklet, with illustrated descriptions of asbesto-metallic and many other kinds of packing. American Steam Packing Company, 60 Federal St., Boston, Mass.

Power Trucks.

A neat pamphlet, with well-illustrated description of the Morgan steam automobile trucks and their parts. Morgan Motor Company, Worcester, Mass.

Pulleys and Clutches.

Illustrated pamphlets, with reports of tests made at the Worcester Polytechnic Institute on "Compo" pulleys and "Compo" friction clutches, whose special feature is the cork inserts. Allston Foundry Company, 620 Atlantic Ave., Boston, Mass.

Pumping Machinery.

General Catalogue No. 42, of 136 pages, with well illustrated descriptions of Smith-Vaile pumping machinery of all kinds, jet and surface condensers, air compressors, etc. The Stillwell-Bierce & Smith-Vaile Company, Dayton, Ohio.

Storage Batteries.

Bulletin No. 73, reprinted from "The Central Station," containing an illustrated description of the installation of Chloride Accumulators in a small central station plant. The Electric Storage Battery Company, Philadelphia, Pa.

Telephone Automatic System.

A well illustrated pamphlet and a neat folder devoted to the Clark Automatic Intercommunicating Telephone system, especially applicable for use in small towns, factories, mills, warehouses, and hotels. The Clark Automatic Telephone Switchboard Company, Providence, R. I.

Telpherage.

Circulars Nos. 22, 23 and 24, with illustrated descriptions of various applications of the telpherage system, in which an electric carriage runs on an overhead single-track or cableway and may be controlled from one end of the line. United Telpherage Company, 20 and 22 Broad St., New York.

Tools.

"D" catalogue, cloth-bound, 300 pages, containing description and price list of fine tools, manufacturers' and machinists' hardware, brass and copper, seamless tubes, platers', polishers' and grinders' supplies, etc. Also a supplement, with changes to January, 1902. Charles H. Besley & Co., 10 and 12 North Canal St., Chicago.

Transformers.

Attractive booklet devoted to electric transformers. The Pittsburgh Transformer Company, Pittsburgh, Pa. New York Office, 120 Liberty Street.